Samples were collected at intervals along the main. The experiments commenced on December 19th, 1909, and continued until January 1st, 1910, and varying quantities of chlorine were used. The best results were obtained at the end of the mile run, and Professor Newlands reported: "It will be seen by these results that when one part per million or more of available chlorine was used the removal of the bacteria was always greater than 99.5 per cent., and the colon bacillus was not found in the treated water."

When Dr. Porter, medical officer of health, Johannesburg, visited this country last summer he evinced great interest in the subject of water purification by chlorine, and I had afterwards the pleasure of sending him the results of my latest experiments. I have no doubt he will shortly communicate the extremely interesting results now being obtained at the Johannesburg Waterworks, where chlorine treatment is used to sterilize several millions of gallons of water per diem.

At the present time, and especially in this country, there is a prejudice against the chemical treatment of water; but the time will probably come when the prejudice will be overcome, and the purification of water by means of chlorine be adopted generally for all supplies of a suspicious character. The cost is so infinitesimal and the results so certain that no other process is likely to prove anything like so economical, and it is scarcely possible for results to be more satisfactory. In this country, where waters containing more than an infinitesimal trace of organic matter are rarely used, very small quantities of hypochlorites will be required, but it may be necessary in many cases to remove the final trace of chlorine by passing the water through polarite or charcoal or iron filings. In this way the water can be purified without affecting the palatability of the water, and the only effect ascertainable by chemical analysis is a decrease in the organic matter as shown by the albuminoid ammonia and oxygen absorbed tests.

A MEDICAL MANIFESTO AGAINST ALCOHOL.—A manifesto signed by 101 medical practitioners in North Wales, 34 of whom are medical officers of health, has been issued in support of total abstinence from alcohol. The signatories of the manifesto appeal to all their medical brethren in North Wales to join them in their endeavour to remove the popular errors that still largely prevail upon the subject.

OBSERVATIONS ON THE INTER-ACTION OF CONCURRENT VARIOLA AND VACCINIA.*

By W. HANNA, M.B., D.P.H., etc.,
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THERE is no subject of medical or scientific interest which has given rise to such controversy as that of the value of vaccination as a protection against smallpox.

The systematic observations of many qualified observers have, however, long since turned this controversy into one of complete victory for the upholders of vaccination as a scientific and prophylactic measure, and it is unnecessary, nowadays, to draw attention to the convincing figures which have proved its value, for they are well known to every member of the medical profession, and especially to those whose duties lie in the domain of preventive medicine. It is sufficient to state that from a long study of the pock diseases of animals, especially vaccinia or cow-pox, and from experiments and observations made by scientists, the relationship of variola and vaccinia has now been established on a firm basis of fact. The experiments of such observers as Thiele, Ceely, King and Hime, and more recently of Klein and Copeman, have shown that it is possible to inoculate a calf with smallpox material and to obtain a vesicle at or near the site of inoculation, identical, or almost so in the first instance, with a human vaccine vesicle. This vesicle becomes even more typical in the case of successive inoculations, and the result is practically the same as if the animal had been inoculated with vaccinia, *for it is no longer susceptible to vaccination*. In addition, the lymph from these vesicles has been transferred and used to successfully inoculate human individuals, and the attenuated virus confers protection against human smallpox as ordinary vaccination does. Cow-pox or vaccinia may therefore be considered as an attenuated descendant of smallpox.

In connection with this close relationship, if not absolute identity, of these two affections, the examination of the following series of 75 cases of smallpox with a concurrent vaccination may prove of interest to those engaged in the work of public health. These cases have been collected during the past nine years in the City and Port of Liverpool. The majority of them were persons who were landed

* Read at a meeting of the North-Western Branch of the Society of Medical Officers of Health on April 15th, 1910.

suffering from or incubating the disease, and were removed to the Port Isolation Hospital; many of them were cattlemen from Boston, who landed incubating smallpox during the severe outbreak in that city in 1902-3. The cases may be examined in the light of the relative effects produced on one another, firstly as regards success of the operation when performed subsequently to infection; and secondly as regards the effect of the vaccination on the course and severity of the disease. Cases of this kind have rarely been given the prominence which they deserve, and it was with this object that the present series was collected. The series then gives information of the effect of vaccination and revaccination performed after exposure to infection.

THE SUCCESS OF THE VACCINATION.

The *success* of the operation may first be considered, and the series may be conveniently divided into two groups, viz.: (1) Those who have never been vaccinated until infected with smallpox (Chart A); (2) those who have been primarily vaccinated in infancy (Chart B).

On examining the charts it will be seen that the period of twelve days has been taken as the duration of the incubation period; this has been found to be practically correct for all the cases, they were all carefully investigated both as to the symptoms of onset and initial rash, and found to correspond to the periods set forth in the charts.

It cannot be disputed that possibly cases may occur with a day or so longer or shorter incubation period, but very few of this sort can be quoted as evidence for an incubation period other than that stated; for public health administration the average period generally accepted and acted on is twelve days, a period which has been found to work out well in practice, the rash appearing three days after initial symptoms.

The first point to notice about these cases is that all have been exposed to the infection of smallpox, and all, with three exceptions, have contracted the disease.

The cases have been set out showing those vaccinated and revaccinated on different days during the period of incubation, or after the onset of symptoms and even until three days after the rash has appeared. It is unnecessary to say that vaccination performed before exposure to infection of smallpox in susceptible people will, almost without exception, prove successful, and will protect the individual from the results of infection.

VACCINATION DURING INCUBATION.

On examining the charts it will be found that all the vaccinations and revaccinations have been *successful if performed during the incubation period* and even up to the day of onset of symptoms. When the term "successful" is used it must be understood that the phenomena at the site went through the typical and normal course of human vaccination. These phenomena may be shortly described as follows: A slight inflammatory reaction may appear at the site, but nothing of moment occurs until the end of the third day, when firm, flat, elevated papules appear at the site of the operation; these become surrounded by a halo of hyperæmia. Vesicles appear on the fifth or sixth day, and are especially marked at the periphery. These are filled with clear lymph and the zone of hyperæmia has increased, with acute swelling; the vaccination area is red, firm and the axillary glands may be swollen. Cloudiness begins to appear in the vesicles on the eighth day, and subsequently they become opaque and yellow. The height of the vaccination is reached on the ninth or tenth day, and from this date there are signs of rapid desiccation. The changes most characteristic of vaccination are found during the third, fourth, fifth and sixth days.

The successful vaccinations and revaccinations recorded in the chart were therefore more or less of the above described characters, and they all showed the characteristic ring or vesicle situated on a papule and going on to supuration and desiccation.

VACCINATION AFTER ONSET OF THE DISEASE.

The operations performed subsequently to the onset of symptoms were unsuccessful: the papule did not reach its typical character, the areola may not have developed and vesicles did not appear, or the vaccine pocks appeared stunted in development and rapidly dried up. In other cases, and notably in those vaccinated late in the disease, no reaction appeared at the site, or simply a slight traumatic reaction occurred. It will be well to mention at this point that fallacious conclusions may be drawn from the appearance of the vaccination area under the following conditions; it is well known that an especially abundant eruption is not infrequently observed on parts of the body which before the eruption appears have been affected by mechanical or inflammatory irritation. Such areas of rash are sharply marked off, and take on strikingly the form of the area of irritation, *e.g.*, a patient

who has been previously carrying heavy bags on his back will show a more profuse eruption on his shoulders, or the irritation in front of the neck caused by a collar-stud will cause a little crop of vesicles to appear at this point. Other examples might be mentioned, such as an eruption round the thigh when a garter has caused pressure, or a confluent eruption on each side of a scratch on the hand. Similar phenomena can be seen after chemical irritation. When a vaccination has been performed, therefore, from the day of onset onwards until the rash appears the inflammation and irritation due to the operation and the slight local reaction which occurs may cause a crop of smallpox vesicles to appear around the area, and this is especially the case in severe or confluent smallpox. These vesicles may coalesce and give rise to a false appearance of success of the operation of vaccination. Many cases therefore said to be successful are really due to coalescence of smallpox vesicles and pustules around the area of the vaccination. This, I am convinced, is the case; it is only likely, however, to give rise to doubt in cases of severe or confluent smallpox where the eruption is profuse.

CLINICAL SOCIETY'S REPORT.

These observations were completed almost a year ago, when attention was drawn to a report, published in 1878, of a committee of the Clinical Society of London formed to investigate the periods of incubation, contagiousness of smallpox, etc. In this report there are twenty-two cases of concurrent variola and vaccination recorded by Dr. Birdwood, of the Metropolitan Asylums Board's hospital. Some of the cases are incomplete in their details, but I have taken those which can fairly well be used in comparison. These have been arranged in the same type of chart as that of the present paper, and it is surprising to find a very close agreement (Chart C).

It will therefore be abundantly evident from the charts that the operation of vaccination performed at any time during the incubation period will be successful. This may be true even during the first period of onset, but if carried out subsequently to the initial symptoms the vaccination will not be successful. Dr. Birdwood states that he has "only found one vaccination which was successful if vaccinated on the day of eruption or after." In my opinion, and for the reasons which have been given, the case was probably not a successful one, the appearance of success having been given by

the coalescence in a confluent case of the vesicles and pustules around the irritating zone of vaccination. In the same report Dr. Colclough, who was at that time assistant medical officer at the hospital ships, in a note says, "The few instances in which I have vaccinated patients on their admission, when the eruption has been in the macular or papular stages, the revaccination has failed, and the reports of over fifty cases of revaccinations (taken from the case books) in various stages of eruption coincide with my few instances."

I have often heard the statement made by medical men, that, when persons have been vaccinated and the operation is not proving successful, there is a likelihood of them developing smallpox, or that these cases ought to be watched and isolated. In my opinion, it is those cases of vaccination which show evidences that the operation will probably be successful, and where there is a low immunity, in which smallpox is likely to develop; these are the cases which require observation. Some time ago, a vessel arrived in Liverpool having had a case of smallpox on the voyage; the man died and was buried at sea five days before reaching Liverpool. All the crew were vaccinated on arrival; one of them who had assisted in burying this man developed a very mild rash of smallpox ten days after vaccination and the arrival of the ship; his vaccination had taken in three places, and showed typical vesicles and other associated signs. Therefore, assuming that the vaccinations have been properly performed with active lymph, the cases to be watched more particularly are those showing signs of the vaccination "taking."

INFLUENCE OF VACCINATION ON COURSE OF THE DISEASE.

Another side of the subject may now be studied with advantage, namely, the influence of this vaccination on the course and severity of the disease.

The degrees of severity have been classed into six groups, numbered in columns 1 to 6. Column number 3 is the type representing a moderate attack; column 2 represents mild, and column 1 very mild; a severe type is represented in column 4, and very severe in column 5; whilst deaths are recorded in the last column.

On an examination of the thirty-one cases with *no primary vaccination* in Chart A, it will be seen that of cases one to five, vaccinated within the first three days of infection, three

CASES UNVACCINATED BEFORE INFECTION WITH SMALLPOX.

No.	Probable day of infection.	DAY OF DISEASE ON WHICH VACCINATION WAS PERFORMED.																				Result of Vaccination.	Severity of Disease.*						REMARKS.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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CASES WITH PRIMARY VACCINATION BEFORE INFECTION WITH SMALLPOX.

[illegible]

No.	Probable day of infection.	DAY OF DISEASE ON WHICH VACCINATION WAS PERFORMED.																			Result of Vaccination.	Severity of Disease.		REMARKS.		
		Incubation Period.									Onset.		Rash.										Discrete.		Confluent.	
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No.	Probable day of infection.	DAY OF DISEASE ON WHICH VACCINATION WAS PERFORMED.																			Result of Vaccination.	Severity of Disease.		REMARKS.		
		Incubation Period.									Onset.		Rash.										Discrete.		Confluent.	
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No.	Probable day of infection.	DAY OF DISEASE ON WHICH VACCINATION WAS PERFORMED.																			Result of Vaccination.	Severity of Disease.		REMARKS.		
		Incubation Period.									Onset.		Rash.										Discrete.		Confluent.	
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C DR. BIRDWOOD'S CASES OF CONCURRENT VARIOLA AND VACCINIA.

No.	Probable day of Infection.	DAY OF DISEASE ON WHICH VACCINATION WAS PERFORMED.																			Result of Vaccination.	Severity of Disease.		REMARKS.
		Incubation Period.									Onset.		Rash.									Discrete.	Confluent.	
I	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Successful	Discrete.	Confluent.		
1.	V																			...	...	...	Malaise, fever, etc., no rash.	
2		V																		...	X	...		
3			V																	...	X	...		
4				V																...	X	...		
5					V															...	X	...		
6						V														...	X	...		
7							V													...	X	...		
8								V												...	X	...		
9									V											...	X	...		
10										V										...	X	...		
11											V									...	X	...		
12												V								...	X	...		
13													V							...	X	...		
14														V						...	X	...		
15															V					...	X	...		
16																V				...	X	...		
17																	V			...	X	...		
18																		V		...	X	...		
19																			V	...	...	...	Apparent success due to irritation and inflammation.	
20																				...	...	...		X
																				Not successful				
																				"				

v = Successful vaccination. A = Unsuccessful vaccination. † = Doubtful.
 * Severity of disease : 1, very mild ; 2, mild ; 3, moderate ; 4, severe ; 5, very severe ; 6, death.

developed no symptoms or signs of the disease, whilst two had an exceedingly mild attack after an initial malaise. In these only a few spots appeared which never became vesicles, but simply died away; in these aborted cases, the smallpox had just overcome the protective effect of the vaccination.

Tracing the cases further on in the disease, we find that the type becomes more or less severe, according to individual susceptibility, until we come to those of moderate severity, vaccinated from the eighth day of infection up to the onset; following on this the cases vaccinated after the onset of the disease will be seen to have been of the very severe type; three of them ending fatally, showing that cases vaccinated at the stage of onset and after the rash has appeared benefit very little, if at all.

If attention be now turned to Chart B, showing forty-four cases of smallpox with a *primary vaccination*, it is of interest to find that in this group the effect of the primary vaccination is shown on the course of the disease, and along with the vaccination performed concurrently has assisted in modifying its severity.

Further, it will be noticed that in this chart of cases which show a primary vaccination, there are no cases found vaccinated on the day of infection or on the first three days following. This may be accounted for by the fact that the double vaccination has prevented the onset of symptoms or appearance of rash in cases vaccinated on these days, and therefore I have been unable to obtain cases to place on the chart in the position corresponding to these days; this view is also supported by the chart of Dr. Birdwood's cases. It may be remarked, however, that the number of cases is quite too small to draw such conclusions; still, I draw attention to the fact as being one of probably some importance from an administrative standpoint.

On examining the cases vaccinated before the onset of symptoms, it will be seen that in nearly all, the disease was of a mild or very mild type. Taking this portion of the Series B, there are only two cases which lie on the severe side of Column 3 (which represents cases of moderate severity), and in this column only two.

The cases vaccinated after the onset of the disease, and subsequently to the appearance of the rash, show a more pronounced type of the disease; in this case most of the patients had the disease in a moderate or severe form.

It must not be understood, when it is stated

that the vaccination and revaccination were unsuccessful as an operation, that the modified organisms implanted in the system may not have exercised an appreciable immunising effect. Case No. 27 amongst the unvaccinated (Chart A) illustrates this point. A lady, unvaccinated in infancy, contracted smallpox abroad and was vaccinated two days after the appearance of the rash; a slight traumatic reaction occurred at the site of vaccination, with ill-defined papule and aborted vesicle, forming a yellow crust, which was quite atypical. The case passed through a severe attack; towards the twelfth or fourteenth day of the disease, however, when the suppurative stage ought to have been reaching its height, it was surprising to find the pustules rapidly drying and falling off, so that within a day or so they had entirely gone; the resulting scars were totally absent and only marked staining remained, which disappeared under a year, and no trace of the disease can now be seen after some years. This case was, to my mind, a convincing proof of the value of vaccination done subsequently to onset of symptoms, and the operation ought therefore to be performed on all cases admitted to hospital; other cases, not so striking, might be quoted.

The remarkable antagonism of these two diseases can only be explained by a consideration of the question of immunity or concurrent immunities.

This question of immunity would take us too far afield in a paper of this description, and must be omitted; but it may suffice to say that in smallpox and vaccination it is a race between the virulent and the modified organisms; the less virulent and more saprophytic forms grow faster and produce immunity quicker than the more virulent ones. Protection is not acquired at any particular time, but there is a gradual accumulation of immunity in the blood, which usually shows itself to be completed by the beginning of the second week after vaccination.

It would seem from an examination of the charts that nine days after vaccination is the period required to give real evidence of the increasing protection against smallpox.

It is therefore evident that the intensity of the disease bears an inverse ratio to the period of vaccination; the later the disease appears after vaccination the more opportunity for the vaccination to be successful and develop its counteracting immunity; when the smallpox appears early in the course of a vaccination the more severe the course of the disease.

On referring to Chart A of unvaccinated cases it will be seen that cases of smallpox vaccinated within three days after infection will develop very slight or no symptoms of smallpox; and a reference to Chart B shows no cases occurring within the first three days. One may safely infer, therefore, that vaccinations done *within the first three days* of infection in persons with a *primary vaccination* will not develop smallpox, and in those who are *unvaccinated* the chances are that the disease will not develop; or, in other words, vaccination requires nine days to develop an immunity which will neutralize or mitigate an attack of smallpox.

CONCLUSIONS.

The following are the conclusions to be drawn from the series:—

1. That vaccination performed subsequently to infection with smallpox will "take" up to date of onset.
2. That protection is afforded against smallpox by vaccination when performed within three days after infection; but this may not be absolute in cases vaccinated for the first time; the course of the disease will, however, be exceedingly mild.
3. That there is abundant evidence of the value of vaccination in mitigating the severity of the disease when performed at any time after infection up to the day of onset, and even afterwards.

A MEDICAL OFFICER'S GOLDEN WEDDING.—Dr. David Corbet, medical officer of health of Kidderminster, and Mrs. Corbet celebrated their golden wedding last month. Dr. Corbet, who qualified in 1858, has been medical officer of health for Kidderminster for more than a third of a century.

APPOINTMENT OF MEDICAL OFFICER OF HEALTH FOR MERIONETHSHIRE.—The Merioneth County Council has decided to appoint a county medical officer of health, his duties to include the medical inspection of school children, at a salary of £450 per annum, including travelling expenses, a knowledge of Welsh being necessary.

APPENDICITIS.—At a recent meeting of the Farnham Rural Council, Dr. Tanner, the medical officer of health, drew attention to the increased prevalence of appendicitis, stating that he had seen thirty cases in the year. He suggested that it might be due to the use of preservatives in food, the preservatives acting by hiding the presence of decomposition in the food. Dr. Tanner was instructed to write to the Local Government Board on the matter.

THE DUTIES OF THE MEDICAL OFFICER OF HEALTH: SHOULD THEY BE REVISED?*

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AS the object of this paper is to invite discussion on a subject of interest to us all, no apology for its shortness is needed. The practical value of many papers lies in the discussion thereon, and it is through discussion that we obtain instruction.

It may appear presumptuous on the part of an official to even suggest that his duties require revision. If presumption it be, I must plead as excuse—

1. That the legislation of recent years has made the medical officer responsible for the performance of a large amount of routine work.
2. That much of this routine work is unproductive.
3. That such work can very well be carried out by the sanitary inspector or other specially appointed official.
4. That this increase of routine work has considerably decreased the time at the disposal of the medical officer, which could be devoted to such work as specially attaches to his office.
5. That a continuously increasing proportion of his time and energy is being absorbed by clerical work.

Let me enumerate the more important Public Health Acts which have been passed during the twenty-seven and a half years I have been a whole-time medical officer:—Factory and Workshop Act, 1883; Housing of the Working Classes Act, 1885; Dairies, Cowsheds and Milkshops Order, 1885; Infectious Diseases (Notification) Act, 1889; Infectious Diseases (Prevention) Act, 1890; Public Health Act Amendment Act, 1890; Housing of the Working Classes Act, 1890; Factory and Workshop Act, 1891; Public Health Acts Amendment Act, 1907; Housing, Town Planning, etc., Act, 1909; and in addition numerous Regulations of the Local Government Board.

I have stated that the medical officer is responsible for the due performance of the duties imposed by the Acts mentioned. It may be answered that the actual work does not devolve upon the medical officer but upon the sanitary inspector or other official. This may be so in boroughs and large towns where the

* Read at a Meeting of the Northern Branch of the Society of Medical Officers of Health, April 22nd, 1910.