ON THE EXISTING STATE OF OUR KNOWLEDGE OF VACCINATION AND REVACCINATION, AS PREVENTIVE OF SMALL-POX.

By ALEXANDER KNOX, M.D., Physician to the Dispensary, Strangford,
County Down, Ireland.

(Concluded from page 1051.)

An argument, derived from the alleged composition of the lymph, might have been advanced, in confirmation of the identity of the Vaccine and Variolous Diseases, but it has been designedly omitted as premature, until the existence of the phenomena, said to be revealed by the microscope, shall have been confirmed by repeated and careful examination. This part of the subject would, however, be incomplete, without a passing notice of the very interesting observations contributed by Mr. E. Oke Spooner, to the July number (1850) of the *Provincial Medical and Surgical Journal*, p. 367. The purport of that gentleman's views will, however, be best explained in his own words.

"If we examine the Cow-pock and the Small-pox microscopically, as I have done very carefully in every stage, we find that the essential character consists of a number of minute cells, not exceeding the 10,000th part of an inch in diameter, being about one-fourth smaller than the globules of the blood, containing within their circumference many still more minute nuclei, and presenting beyond their circumference bud-like cells, of the same size and character as those contained in the circle. They exactly resemble in everything, except the size, the globules of the yeast plant, the *Torula cerevisia*."

In conclusion, the leading phenomena of the three forms of Small-pox may be thus grouped with reference to their identity.

NATURAL SMALL-POX.	INOCULATED SMALL-POX.	VACCINE SMALL-POX.
General symptoms usually severe.	Usually mild.	Almost invariably mild.
Primary fever, may be typhoid, more usually inflammatory, declining about the fifth day.	No primary fever.	No primary fever.
Eruption of papulæ on the third day, completed on the fourth; papulæ generally numerous.	Minute papulæ on the third day—generally few in number, and sometimes confined to the puncture or its locality.	Minute inflamed papula on the fourth day; the eruption, with rare exceptions, confined to the point of operation.
Papulæ vesicular on the fifth day, and containing pellucid lymph.	Vesicular, with clear lymph on the fourth day.	Vesicle on the fifth day, containing clear lymph.
Vesicles depressed in the centre.	Vesicles depressed in the centre.	Vesicle depressed in the centre.
Redness around the areola, the papulæ assuming a deeper hue, as the pustules ripen.	Pain of axilla about the sixth day; areola on the ninth or tenth day. Fever, sometimes severe, about the eighth day.	Pain of the arm, and sometimes of the axilla, about the eighth or ninth day.
Vesicles assume the form of distinct opaque pustules, either spherical or acumin-	By the tenth day, the primary pustule is full of matter.	Areola on the eighth or ninth day. Fever slight, sometimes inap-

NATURAL SMALL-POX.
ated, about the eighth day, and contain sero-purulent matter, attaining the maximum size of a pea about the eleventh day, when secondary fever occurs.

The pustules break and scab about the twelfth day, and the crusts fall off in a few days more.

Pustules leave, when severe, permanent scars.

INOCULATED SMALL-POX.
No secondary fever.

The primary pustule scabs about the fourteenth day; and by the end of the third week the disease disappears.

Primary pustule, and the secondary pustules, when severe, leave permanent cicatrices.

VACCINE SMALL-POX.
preciable, about the eighth or ninth day.
No secondary fever.

Scabbing takes place about the twelfth or thirteenth day, and the crust falls off about the end of the third week.

Vesicle usually leaves a permanent striated cicatrix.

d. Evidence in favour of the protective influence of Vaccination. This is almost universally prevalent, even up to the present day. The doctrines of Jenner have been advocated, to a greater or less extent, by Baron, Thomson, Good, Gregory, Watson, Alison, and a host of other writers of the first celebrity in these kingdoms, as well as, on the continents of Europe and America, by many of the most eminent medical authorities, to whom we have not space even to allude. Amongst others, Berthollet, Percy, and Hallé, have discussed the subject with great force and precision, in an article published by the French Imperial Institute. The united opinions of such men unquestionably offer the strongest presumption in favour of Jenner's discovery; but the actual extent to which protection is imparted by Cow-pock, is rather a question of fact than of opinion, and is only to be determined, to the satisfaction of the sceptical, by a rigid inquiry into the actual results, and the conclusions fairly deducible from them.

Evidence as to the actual results of Vaccination is the most satisfactory and, after all, the only conclusive method of determining the true value of Vaccination. The general testimony, in favour of the protective influence, either absolute or partial, of Vaccine Inoculation, is still, as we have seen, all but universal; for, even among the many observers who now demur to the unqualified doctrines of Jenner, Baron, and others, there are very few who do not admit, that immunity to a certain degree, and for a limited period, is imparted by the operation. The proposition, however, that it confers absolute protection on all persons ever after, is now admitted, on all hands, to be untenable; but it is the belief of a great many, that where the casual disease occurs after Small-pox, it usually displays itself in a greatly ameliorated shape, which may thus be briefly described.

Modified Small-pox. A secondary attack of Small-pox may occur after Inoculation or Vaccination, or even after a primary attack of the casual disease. The consecutive malady, in rare instances, runs through its course with unabated severity, and may even prove fatal; but, in a vast majority of cases, it exhibits itself in a very mild form. In some peculiar constitutions also, this ameliorated type of the disorder occurs primarily, although the system has not been protected by having previously passed through the disease in any form. The preliminary symptoms and primary fever of the modified disorder differ, however,

in no respect from the first stage of unmodified Small-pox, being equally severe until the appearance of the eruption, when the ameliorating influence, especially of Vaccination, at once becomes evident. The constitutional disturbance rapidly subsides, and the papulæ, usually, though not invariably, limited both in point of number and extent, are confined principally to the face and breast. The pocks, or a portion of them, may, in some cases, pursue their ordinary course; but they more usually moderate by the fifth or sixth day, and rapidly dry up, and many of them die away, without coming to maturity at all, exhibiting neither the usual central depression, nor the presence of purulent matter. Meanwhile, the attendant indisposition is very slight, the appetite perhaps unimpaired, and the patient free from that secondary fever, with all its frightful consequences, which render the unmodified disease so terrible. No permanent scar is usually left by the pocks, the site of which is, however, marked by temporary brown discolorations of the skin. We are, therefore, amply justified in stating, that if the only result of Vaccination had been to substitute this mild disease for natural Small-pox, the value of Jenner's discovery could scarcely be over-rated, even if it had failed to produce absolute protection in a single case. Small-pox in the modified form was termed by the elder writers *Varicella*, and this appellation, with the adjunct *variolodes*, to distinguish it from chicken-pox, was retained by Dr. George Gregory; but its application to any form of Small-pox may lead to confusion, and had better be abandoned by all who do not look on the diseases mentioned as essentially the same. This, however, is a long disputed point, not yet perhaps conclusively determined, but which must be passed by for the present.

It is obvious, that in attempting to fix the true protective value of Cow-pock according to existing information, the correctness of our conclusions must depend on the assumption, that the primary Vaccination has not only apparently, but really, produced its full effect on the system. The value of any inferences arising out of the extensive Revaccinations in the Prussian army, and elsewhere, evidently hinges on this point, and it therefore becomes a necessary preliminary to examine the various alleged tests of effective Vaccination, which may be enumerated as follow: Bryce's test; the cicatrix left by the Primary Vesicle; Variolous Inoculation, and Revaccination.

Mr. Bryce's well known test of the disease having affected the system was this: he performed a second Vaccination, at the end of the fifth or beginning of the sixth day, from the date of the first operation. The vesicle, produced by the second Vaccination, was found to be not more than one-fourth of the normal size, and the areola was equally diminished, being also accelerated in its progress, so as to arrive at maturity, and again to decline, at nearly the same period as the affection depending on the primary operation. This test was not held to be of much consequence by Jenner; and Gregory objects to it, that although it shows the constitutional influence to have been excited, it does not determine whether in a sufficient degree to secure the system, and he justly looks on it as being absolutely nugatory, as a test of the stability of vaccine protection in after-life.

By many practitioners, a perfect cicatrix left after the primary operation, has been considered as a certain test that the protective influence

has been duly imparted to the system. The proper characteristics of this cicatrix are stated to be, permanency and a diameter of about rather less than half an inch, its surface being striated, and marked with six or eight slight indentations, corresponding to the cells of which the vesicle was composed. As far, however, as the question is to be determined by the investigations of the Wirtemberg physicians, it does not appear that the state of the cicatrix can be relied on to determine whether, and how far, the system is protected, either by the primary operation, or by Revaccination. Genuine pustules may leave no mark at all, or an imperfect mark; and even a true cicatrix will only show, that Vaccination has been duly performed, but not how far the protective influence still remains in the system, if we admit what their statistics apparently show, that the protection may be diminished, or entirely lost, at varying periods from the date of the operation. In proof of this it is stated, that of 1055 cases of Small-pox, in which the marks were visible, 914 had good, and only 141 imperfect marks, and 147 of the above cases were of genuine Small-pox, although the marks were normal. And of 2718 revaccinations, one half had the cicatrices from the previous operation regular; yet in this half, Revaccination succeeded perfectly in 65 per cent.; in a modified manner in 26 per cent.; failing entirely in only 9 per cent. In further illustration of this point, we are informed, that, out of 14,384 Revaccinations amongst the military, in more than one half the marks were normal, yet of this number the process went on regularly in 31 per cent., and in a modified manner in 31 per cent, whilst in 40 per cent. no effect whatever was produced. Again, in the Prussian army, according to Lohmeyer, 42,041 soldiers were revaccinated; and of these 33,819 only had distinct, and many no marks whatever; yet the secondary operation was regular in 19,117, irregular in 8,672, and failed entirely in only 14,252 cases.¹ On the other hand, protection from the primary Vaccination may exist, where no trace of a cicatrix remains, as illustrated by 2,030 cases, in which Revaccination failed altogether in 47 per cent.; had a modified result in 19 per cent.; and succeeded perfectly in only 34 per cent. The testimony of Gregory² is to the same effect, severe forms of Small-pox occurring where the cicatrices were normal, and very slight forms where they were very imperfect. A better criterion, therefore, would be satisfactory proof of the previous process having been complete; but, as this can rarely be attained, we must depend chiefly on the character of the operator as a guarantee for the regularity of the primary Vaccination.

Cazenave and Schedel consider the best test to be Inoculation with variolous matter, the usual effect of which, if the previous Vaccination have been successful, is to produce a small local pustule, which dries up rapidly, and is not accompanied, for the most part, with any constitutional symptoms, although it may be followed by a slight general eruption. They admit, however, that this method is not without inconvenience. Inoculation, although a good test in itself, is objectionable, as tending to diffuse the contagion of a very terrible malady; for though the inoculated disease

¹ *Medicinische Zeitung*, in *Brit. and For. Med. Rev.*, No. xv, p. 263.

² *Med. Chir. Trans.* vol. vi, second series.

in any given case may be of the mildest form, it may convey, by infection, the most malignant type of the disease to others.

Another mode of testing the efficacy of Vaccination is by a secondary operation, a Revaccination, after the lapse of varying periods of time. The effects of this secondary operation are various, and have been minutely described by Dr. Gregory. In some cases, certainly the majority at least within five years, the puncture in the skin heals in a few days without any subsequent results, or it may produce a degree of common inflammation. In others, a greater effect is produced, and in three or four days after insertion, a small vesicle, containing transparent fluid, is produced, but it is acuminate, and dies away about the eighth day. Or the vesicle may resemble the genuine one in other particulars, but is flat, does not attain the usual size, and dries up without leaving the characteristic mark; or it may be perfect in every respect, except in the existence of the areola. These imperfect vesicles may be destitute of any concomitant marks of inflammation, or they may be affected with troublesome itching, surrounded by an areola, irregular either as to size and colour, appearing sooner than the genuine pock, about the seventh or eighth day. The glands in the axilla swell very frequently; and a marked degree of redness and engorgement of the arm, with occasional smart feverishness, may exist. These symptoms are especially common in the female sex. The principal points, therefore, indicative of a spurious disease, are anticipation of the various stages, the whole progress being too short, irregularity of the vesicle, which may be too small, or acuminate, or pustular, instead of vesicular, and absence of the regular cicatrix.

But, after all, the best and most certain test that Vaccination has imparted its full influence to the system, is the regular progress of the vesicle, with its attendant symptoms, through all its stages, which have been minutely described in a former part of this paper.

In returning to the main question, it may be premised, that the protective influence of Cow-pock has been advocated on the following grounds:— 1. The power which it confers of resisting the contagion of the casual disease. 2. Of resisting the effects of Variolous Inoculation. 3. Of resisting the effects of Revaccination.

1. In proof of the first of the positions here stated, it was related by Jenner himself, that 6000 persons had been vaccinated, who entirely resisted the contagion of Small-pox, although exposed to it in almost every way for the express purpose of determining the question. The history of Vaccination in Denmark offers similar testimony; for in consequence of rigidly enforcing the practice in the first instance, Small-pox disappeared from that kingdom, but only to reappear and renew its ravages, when supineness had grown out of continued immunity. So also in Ceylon, as clearly shewn by Dr. Kennis, the extent and fatality of the malady alluded to were regulated by the degree of attention paid to Vaccination. When this was duly attended to, secondary Small-pox was both unfrequent and mild: thus of 737 cases, 550 were without satisfactory marks of Cow-pock, and of these last 198 died, or 10 in every 28; whilst of the remaining 187, with satisfactory marks, the deaths amounted only to 3, being in the proportion of 1 to 62. This evidence to shew, that the vaccinated, when exposed to the contagion of

natural Small-pox, escape the disease in a far greater proportion than those who are unprotected by the operation, might be greatly enlarged. For example; in the history of the epidemic which prevailed in Copenhagen for three years, commencing in 1828, written by Wendt, it appears that of 84 patients affected with true variola, and who had not been previously vaccinated, 24, or 1 in $3\frac{1}{2}$, died, whilst of 29 who had been vaccinated, only 4, or 1 in 7, died. The results in 1832-4 were still more strongly illustrative of the same position. Of 147 persons, not vaccinated, or on whom the operation had only been performed eight days previously to the breaking out of the Small-pox, 34 died, *i. e.* 1 in 4; whilst, on the other hand, only 10, or 1 in 90, died out of 898 who had been vaccinated. Again, of 179 affected with the true disease, 119 had not been vaccinated, and the mortality amounted to 34, or 1 in $3\frac{1}{2}$; whilst of there remaining 60, who had been vaccinated, 10 died, or 1 in 6;¹ of 1043 vaccinated patients in Copenhagen, there died of Small-pox 47; of 123 not vaccinated, partly because they had *had the Small-pox*, 51 died; on the whole, of the vaccinated, there died about 1 in 22; and of those not vaccinated, about one-third fell victims.

The most recent results, which have fallen in my way with reference to this part of the subject, are contained in the last quarterly report of the Registrar-General. They shew the obstinate prejudice which still exists against Vaccination, especially amongst the lower classes, in many parts of the country, and also the great amount of protective influence conferred by the operation. Small-pox, it appears, prevailed epidemically at Lewisham in Kent, and, with the exception of five cases, all the deaths occurred in the unprotected; in East Maidstone district, in eleven fatal cases, eight had not been vaccinated; in Walcot district, Bath, fourteen died, twelve of whom had never been vaccinated; in Bath Eastern district, four individuals died, who had not been submitted to the operation; in Nottingham, St. Ann's district, six deaths occurred under the same circumstances; and in another district at the same time, in eight fatal cases out of ten, vaccination had not been practised.²

It is not necessary, however, to adduce farther testimony on this point, as enough appears to shew, that the immunity from casual Small-pox is infinitely greater amongst the vaccinated, than the unvaccinated portion of the community. And the same conclusion is deducible from the comparative results of variolous inoculation, accordingly as the recipients have, or have not, been previously vaccinated.

2. With very few exceptions, all persons are susceptible of the contagion of Small-pox, by inoculation; and the disease, when thus conveyed into the system, may be more or less severe, but always passes through its different stages, with due regularity, as described in a previous part of this essay. But supposing the individual to have been vaccinated, the results, as far as they have been investigated, appear to be totally different, in the vast majority of cases. The most usual effect of the operation, according to Cazenave and Schedel, is to produce merely a

¹ British and Foreign Medical Review, No. ix.

² See LONDON JOURNAL OF MEDICINE, No. xxi, September 1850, p. 920.

small local pustule, which rapidly dries up, and more rarely a slight general eruption, for the most part unattended by any active constitutional symptoms. On the other hand, as we are told by Gregory, Vaccination, practised after variolous inoculation, is usually followed by no effects whatever. In rare instances, a modified Cow-pock is produced, the lymph of which cannot be trusted (nor in common prudence should it be), to reproduce the genuine disease.

But the effect of inoculation, at periods remote from the primary Vaccination, are very little known, owing to the difficulties in the way of instituting the inquiry. The experiments, as far as they have gone, are presumably in favour of Vaccination; at least it was demonstrably shewn by Woodville and Jenner, that for three years at least, after the operation, the system appears to resist entirely the effects of variolous inoculation, and analogy favours this view of the case.

8. The last point to which we shall refer, as demonstrative of the influence of Vaccination, is the observed results of Revaccination.

This part of the subject has attracted great attention of late years; and the increasing anxiety in the public mind, as to the real protection conferred by Cow-pock, is traceable in a great measure to the German statistics on this head, coupled with the renewed prevalence of Small-pox: yet both causes of anxiety have, as we think, been greatly overrated, as we shall endeavour to shew in the sequel. It should be premised that Schlesier, Heim, and some other writers, take for granted, that the success of a second operation for Cow-pock, shews the constitution to be equally liable to the casual contagion of Small-pox; and although the identity of the diseases in question may be urged in favour of their views, still it does not by any means necessarily follow, that a vaccinated person, although again susceptible either of the vaccine or variolous virus, when applied in a material form, should be equally liable to contract the disease by atmospheric transmission. This is a point only to be determined by very ample observation.

But assuming for the present, that the receptivity of one form of disease, indicates in an equal degree the receptivity of the other forms, what do the results of Revaccination shew? We shall first state the facts, and then draw our conclusions. In the experience of Lohmeyer, of 48,000 persons revaccinated, 37,000 presented evident traces of previous infection, yet 15,000 had the disease afresh, 12,000 took it imperfectly, and 21,000 not at all; and of this last number, one-third contracted the disease on a second Revaccination, the remaining 3,000 escaping altogether. And of over 44,000 persons, revaccinated in Wirtemberg, during five years, 20,000 were operated on with perfect, and 9,000 with modified success, and in 15,000 the operation failed altogether. Finally, in England, in 1837, forty-five persons in the hundred are described as exhibiting true vesicles after Vaccination.

Now, looking at these details in the most unfavourable point of view, they shew that in many thousands of cases taken indiscriminately, and re-vaccinated at various periods from the date of the primary operation, one-half, at least, were shielded entirely or partially from a second attack of Cow-pock, and therefore, according to the views of the German physicians, from a consecutive attack of Small-pox. Neither, in aiming at a fair conclusion, should it be left out of view, that many of the persons

operated on may not have had the disease, in a genuine and regular form, after the primary operation. This would be a very unfair way, no doubt, of accounting for all the failures, but a certain proportion of them may thus be reasonably disposed of. It may fairly be assumed also, that amongst the large numbers experimented on, many would be found, with that strong susceptibility of the contagion, which imposes liability to a second attack, even after the patient has gone through a regular irruption of the casual disease. But with all deductions, it must be conceded, that a secondary Vaccination may unquestionably succeed, in a certain proportion of cases.

e. Causes of Failure of Vaccination. Admitting, as all authorities to a greater or less extent do admit, the partial failure of Cow-pock, it becomes important to examine the various causes to which this has been attributed. Of these, some seem calculated rather to occasion manifest imperfection of the vesicle during its progress, than to account for failure of the protective influence, after the disease has apparently gone through its regular course.

A careless and inefficient manner of performing the operation, has been strongly urged, in the report of the Vaccine section of the Provincial Medical and Surgical Association, principally drawn up by its chairman, Dr. Baron, and this has been principally relied on by the followers of Jenner, to account for the want of success. Without, however, going the whole length with that able writer, we believe that the actual number of failures has been exaggerated, and also that a certain proportion of them, but by no means all, may be fairly attributed to the imperfection of the primary operation; as the secondary occurrence of the disease, after the most careful Vaccination, has been placed beyond doubt.

Of the other assigned causes of failure, which appear worthy of being examined in detail, perhaps the most important is the employment of unsuitable virus. Thus if the lymph be taken from a spurious pock, or from a genuine pock at too late a period, we shall in the latter case possibly, and in the former certainly, fail to impart the true protective influence by Vaccination. It has, therefore, always been considered a matter of practical importance, to determine the most suitable period and mode for selecting the lymph for the purpose of transmission. Vaccine matter taken before the eighth day has been objected to, but on no good grounds, except that it is difficult to procure it in sufficient quantity, and as interfering with a desirable uniformity of practice. The period at which it is usually selected is the eighth day, in accordance with the calculation of Mr. Jefferson, the President of the United States of America, who determined, after the most careful investigation, "that the point of time counting from Vaccination, when the matter is genuine, is, in all cases, eight times twenty-four hours." And, for the sake of uniformity, it appears desirable that this rule should be adhered to. But if the progress of Vaccination have been at all retarded, the lymph occurs in greater abundance, and is equally efficient, on the ninth or tenth day. Its employment, after that period, is justly condemned by most writers on the subject; for it will very often fail to communicate the disease. But at whatever stage the virus may be taken, provided it succeed at all, the resulting vesicle will be the same both in appearance and efficiency, as is clearly shewn by the successful effects of

vaccinating with the dry crust. This view of the case is sanctioned by the high authority of Dr. George Gregory,¹ and it appears to be more consonant with the fact than the assertion of Willan,² that Vaccination may fail, from the employment of lymph selected on or after the tenth day. In my own experience, I have almost invariably found the vaccine matter, existing in sufficient quantity for transmission, and perfectly energetic, on the eighth day, at which period I have, therefore, made it a rule of practice to operate.

The uncertainty of lymph, taken later, has been attributed to its being diluted with the common product of inflammation; but the experiments of Adams, and of M. Bousquet, conclusively shew, that diluted lymph may be perfectly efficient.

Great objection is made by some parents, especially in the better classes of society, to allow the matter to be taken at all from the arms of their children, but less so amongst the more ignorant, many of whom look on the taking off the pock, as they term it, practised for the purpose of procuring a supply of lymph, as a necessary part of the process. Good feeling will induce us to comply on ordinary occasions with the first-mentioned prejudice; but if every parent were selfishly to act on this principle, the supply of matter could not be kept up, and Vaccination must in a great measure cease altogether. If properly and gently done, no evil can arise; but it is a different question, whether all the vesicles may be exhausted without prejudice to the individual, or to the protective influence of the operation. Heim attributes great local irritation to the exhaustion of all the vesicles. The lymph of a primary is said to be more effectual than that of a secondary Vaccination, and it would require much stronger evidence than that offered by Heim, to convince us that it is desirable to employ the product of a revaccinated vesicle, especially if taken from an adult, which last, he says, is more energetic. In such cases, we should be sceptical both as to its purity and superior efficacy; and his assertion that vaccine matter is scarcely susceptible of mixing with any other virus, would, in no degree, lessen our fears of transmitting by inoculation the poisons of syphilis, scabies, and perhaps of other diseases. Consequently, nothing but the impossibility of obtaining matter from any other source, when urgently required, would overcome the objection just stated. Exhaustion of the entire lymph, in any given case, either by accidental rupture, or for the purpose of transmission, without leaving at least one vesicle entire, is another alleged cause of abortive Vaccination. Heim, we have seen, attributes great local disorder to the practice of exhausting the lymph in all the vesicles, and he mentions one case in which death from convulsions ensued three weeks thereafter. Grave doubts may be entertained, however, whether the convulsions were fairly attributable to the cause indicated; and the inflammation and irritative fever, occasionally of a severe character, which sometimes supervene, are attributable rather to the rough and too often repeated application of the lancet, than to the exhaustion of the lymph. We question farther whether any abatement of efficacy, in Vaccinations otherwise perfect, is a result of the cause above mentioned. Were the exhaustion of the virus to take place before the constitutional

¹ Med. Gaz., vol. xiii, p. 441.

² On Vaccine Inoculation.

effects of the operation have arisen, some weight might be attributed to this alleged cause of failure; but at the period when the lymph is usually removed, the disease has affected the system, and it may be presumed therefore that its progress is no longer controllable by any local influence exerted on the part. Hence it may be questioned, whether, even if the vesicle were extirpated, or the arm amputated above the point of operation, the protective influence would be thereby affected. Still, to obviate a possible source of error, it is desirable to leave at least one vesicle unmolested. The question will thus be narrowed, and if failures occur, they cannot, at all events, be attributed to this cause. At the same time, a high degree of inflammation, however arising, may render it prudent to repeat the operation; and the same may be said of a very slight degree of local irritation, or of any deviation whatever from the ordinary and regular phenomena of the process. With reference to this point, it may be further observed, that Jenner directed the superficial lymph, oozing from a slight puncture, to be employed, whereas Dr. Walker detached the epidermis from the vesicle, and used in his Vaccinations the virus which exuded from its floor; and we are told by Dr. Gregory, that the result of one mode of procedure has stood the test of time as well as the other.

Many German writers, and especially Heim, allege that the number of punctures materially modifies the result, and that the production of a single vesicle is not adequate to secure the system from a subsequent attack of Small-pox. They argue, moreover, that the protective power is increased by creating an evident constitutional disturbance, which they endeavour to excite by making a considerable number of punctures, their custom being to revaccinate if one alone comes to maturity. With this view, Camerer, Wanner, Eichorn, and at one time Gregory, who subsequently abandoned the practice, advised the production of twelve, fifteen, twenty, or even thirty pustules. The effect of this must, no doubt, have been to raise a considerable degree of constitutional excitement, but attributable rather to the local inflammation of the numerous sores than to any specific effect of the infection on the system. On the contrary, the high degree of fever thus produced, would seem calculated rather to check than to promote the regular progress of the disease, not to mention, that severe inflammation, gangrene, convulsions, and even death, have been the result of this plan of over-scarifying; and on the whole, the practice may be regarded, not only as cruel and useless, but even positively dangerous; and the supposed advantage is too questionable to justify us in incurring such a risk. And there are good grounds for believing that one genuine vesicle, passing regularly through all its stages, is as effectual as a dozen; but it is convenient to make three or four punctures, to multiply the chances of infection, especially where dry lymph is employed, as well as to augment the supply of matter. For these reasons, except at the express desire of the parent, my invariable practice is to make three punctures on the same arm (to inoculate both is inconvenient not only to the child but the nurse), at such distances as may prevent confluence of the vesicles in their maturative stage.

Deterioration of lymph, arising from its transmission through a great number of individuals, is alleged by Prinz, and many others, to affect

the results of Vaccination, and it is admitted by a few, that such deterioration may actually take place, but only through carelessness or want of due skill. Dr. Baron, on the other hand, expresses his unabated belief in the opinion, that the Cow-pock virus, after transmission through many hundred persons, is now what it was in the beginning. The same view is taken by a recent writer in the *Medical Gazette*, Mr. John Patterson, who expressly affirms that deterioration of the vaccine virus is never a cause of failure, which is attributable to operating with lymph taken before the ninth day, when the pock is matured. The cases which he brings forward, however, even as far as they go, would merely show that the infection is more readily transferred at the later period; but they prove nothing as to the relative degree of protection conferred where the operation succeeds.

It is asserted by Dr. Gregory, that the number of punctures should have reference to the energy of the matter, which, after being long humanized, is alleged to be less active than that more recently derived from the cow, one vesicle with the latter being equal, in his opinion, to five or six made with the former. In these views we cannot concur, as we think that they are neither supported by the analogy of other diseases, nor demonstrated by sufficient experience. In fact, the alleged deterioration of vaccine lymph, in its progress from one individual to another, is a mere hypothesis, and therefore more importance is safely to be attached to the genuine appearance of the vesicle, and the regularity of its progress, than to any theoretical notion about the quality of the lymph, or the source from which it has been derived. It is further obvious, that the hypothesis, which we are discussing, would fail to explain the failures which occurred in the earlier history of Vaccination, even in persons vaccinated by Jenner himself.

The employment of dry lymph cannot be set down as a source of failure of the protective influence, although it may, and indeed is, a frequent cause of failure of the operation. Where liquid matter can be procured, it is always to be preferred; although a regular vesicle proceeding from dry lymph, or even from the scab, is equally efficacious. As it is impossible, however, in any given place, to keep up constantly the supply of fresh vaccine matter, it is of consequence to determine how it may be best preserved and transmitted from one country to another. When vaccine lymph is to be employed within a few days, it may be kept in an effective fluid state, either in small capillary tubes, having a central bulb, or in small bottles, with projecting ground stoppers, as pointed out by Dr. Gregory;¹ but when thus preserved, it is alleged by some authorities to produce an irritable vesicle. Where it is necessary to keep the matter for several weeks, or months, this may be most effectually done by preserving it between two portions of glass, or on ivory points, repeatedly dipped in the lymph whilst liquid. In the Vaccine Establishment in Dublin, they employ the former, and in London the latter method. The ivory points, gratuitously issued from the Royal Small-pox Institution, I have been in the habit of using from time to time for several years, and I have invariably found the lymph both genuine and effective, and the same may be said of the supplies which I have pro-

¹ Cyclop. Prac. Medicine.

cured from the sister metropolis. For transmission to warm countries, the virus is found to preserve its virtues better in the form of crust than by any other method, being simply diluted when it comes to be used.

An irregular vesicle, or modified Cow-pock as it has been termed, should always be looked on with doubt, if not as demonstrative of the non-effective nature of the operation. It may, and perhaps most usually does, arise from some defect in the lymph; but the same result may arise from the most genuine virus employed in a cachectic constitution. No more conclusive proof can be given of this than the well-known fact, which I have repeatedly observed, of the occurrence of the genuine and spurious vesicle, in different individuals, infected with the same lymph. But even when the vesicle in other respects follows its regular course, it is the opinion of some writers, that the formation of purulent matter after the ninth day, indicates a pock in which due confidence is not to be placed, and especially if the consecutive crust is friable, and of less than the usual dimensions. At all events, any vesicle not following the normal course elsewhere described, especially if approaching the irregularities of form, described under the appellation of degenerate pock by Sir Gilbert Blane, cannot be depended on; as where the vesicle is amorphous, or uncertain; the fluid straw-coloured, or purulent; the areola either absent altogether, or confused with the vesicle, or where there is premature formation of the scab. So also the operation is not to be relied on, if, after extreme itching, or premature efflorescence, the vesicle attain its height about the fifth day, or if it shall assume a conoidal acuminate form, or display the characters of a common festering sore. It is equally objectionable when the pock becomes scaly, or the areola is superseded by a species of psoriasis, or by erysipelas. In all such cases, the undeviating practical rule should be to operate again and again, until the disease goes through its regular form, or until we ascertain, by repeated trials, that there is some insusceptibility of constitution, which would probably protect the individual equally against Small-pox. At any rate, the choice remains, in such cases, after a fair trial of the operation at due intervals, between Variolous Inoculation, and leaving the patient to take his chance. Should the failure depend on some derangement of the health, we may succeed after removing this; but in certain constitutions the insusceptibility is permanent. Mr. Crosse calculates that 1 in 50 were thus insusceptible.¹

Age. Heim advises that no child should be Vaccinated before the termination of the first year, from a theoretical belief that, during that period of life, there exists in the constitution something resistive of the protective influence. In this mode of accounting for failure of Vaccination, and more especially in the advice founded on it, it is impossible to concur, as no sufficient or valid proof has been offered in its support, and the reasons for an early operation are too cogent to be set aside on any speculative grounds. Ryan advises the operation to be performed after the sixth week, and Cazenave and Schedel not before that period, without pressing indications. The opinion of Capuron, which I quote from the Italian translation, having neither the original French, nor an English translation at hand, is to the following effect. "L'esperienza

¹ On Variolous Epidemic of Norwich, p. 32.

attesta, che l'operazione riesce quasi egualmente benigna nel neonato di venti quattr'ore, o di cinque o sei giorni; soltanto se osserva che la Vaccina è più regolare, ed accompagnata da una febbre più mite dai due ai sei mesi; ecco perchè quest' epoca della vita è preferibile ad ogni altra."¹

In all cases where a child has been exposed to the contagion of the casual Small-pox, we should perform the operation of Vaccination forthwith, in the hope that the milder may anticipate the more malignant malady. The results of our interference will, however, prove to be various, according to the period at which it takes place. Where the vaccine lymph is inserted during the incubative, but still latent, stage of Small-pox, the effect, as stated by Gregory, is, that the latter disease runs through its course unmodified, whether the Cow-pock, as is most usual, either does not advance at all, or at least tardily and imperfectly; or whether, as may more rarely be observed, it passes through its usual process, at the same time as the casual disease. Cazenave and Schedel, however, state, that in vaccinating an infant exposed to variolous contagion, the Small-pox will sometimes adhere to its usual progress, but more frequently assume a modified type; and that, occasionally, even a confluent form of the disease will pursue its regular course, concurrently with the Vaccine eruption. At any rate, the prudent course, in case of exposure to variolous infection, is at once to vaccinate, in the hope that the germ of the casual disease may not yet have been imbibed.

The following strong practical reasons for an early operation are supplied by the Registrar-General in his First Report for the year 1839. At Bath and Liverpool, 22 children died, between birth and the second month, of Small-pox; 41 between the third and fifth months; 54 between the sixth and eight months; and 59 between the ninth and eleventh months, amounting in the whole to 176 deaths within the first year; whilst 158 children perished from the same disease in the second, and 110 in the third year.² Mr. Farr therefore advises Vaccination to be performed within the third month.

When Variolous Inoculation was generally practised, the fourth month was the period selected for the operation, and the same period is well adapted for Vaccination. In my own practice, I usually select any age from the third to the fourth month, if no constitutional disease, or other circumstance be present to contraindicate the operation; vaccinating, however, at an earlier period, if there be any risk of contagion from the prevalence of casual Small-pox. The period advised by Gregory is between the third and fifth months, when the child has acquired plumpness, and before dentition has commenced. Capuron considers the spring and autumn to be the best seasons of the year for Vaccinating; but this is a point of trivial importance, and at any rate, inconsistent with the rule of practice laid down as to the infant's age, the observance of which will of course impose on us the necessity of operating at all periods throughout the year.

According to Heim and some other writers, the process of teething does not interfere with the due results of Vaccination; but it appears to

¹ CAPURON. Tratt. delle Bambini. Ed. Nap. p. 211, 1828.

² Brit. and For. Med. Rev., No. xviii, p. 353.

us, and many of the best authorities might be cited in confirmation of our opinion, that febrile excitement, from whatever extraneous causes it may arise, seems certainly calculated to interfere with the regular development of the disease; and dentition, if accompanied by fever, offers no exception to the rule.

In cases where the formation of the teeth is unattended by any very evident constitutional disturbance, the Cow-pock may possibly pursue its regular course; but, except for some urgent reason, Vaccination should not be performed at all during the period of dentition.

It is further asserted by Heim, that inflammations, certain fevers, and influenza, so far from interfering with, assist and hasten the effects of Vaccination; whilst nervous fevers, as he alleges, as well as hæmorrhages, dysentery, and cholera, retard their progress. Jenner also expressly states, and in this Gregory coincides with him, that the process of Vaccination will be delayed, perhaps for many days, where the infection of measles or scarlatina has been imbibed before the operation.¹

Heim is again at issue with both Hering and Jenner, as to the influence not only of acute, but of chronic diseases of the skin, asserting, that herpes and itch usually exert no essentially modifying influence on the progress of the vesicle, whilst Hering positively affirms the modifying power of the last mentioned complaint; and it is set down as a law by Jenner, that the pre-occupation of the skin by any disease capable of affording a humour, is "the grand impediment to the success of Vaccination."

By Capuron, not only the process of dentition, but the periods of puberty, pregnancy, child-birth, and menstruation, are enumerated as unsuitable for the operation. Now it is quite possible, that the vaccine process may at times appear to go through its various stages regularly, under the circumstances described; but the more prudent course will be, never to vaccinate, except under exposure to variolous contagion, when the system is deranged from any cause whatever. By following this plan, one source of error, in ultimately arriving at the exact value of Vaccination, will be avoided; nor can the discovery of Jenner be said to have a fair trial, if the regulations laid down by him be not strictly attended to.

Retardation of the infection is another assumed cause of failure of the protective influence. It is well known, that a vesicle arising from the most genuine lymph, may, from non-absorption, or some unknown cause, be delayed in its progress, for a day or two, and occasionally for so long a period as eight, ten, twenty, or even twenty-five days, and the disease may afterwards pass through its various stages with perfect regularity. In one individual in the Prussian armies, the pock did not appear until six weeks after the operation; and in a child properly vaccinated with dry lymph, in whom no effects were observable, a number of fresh punctures, with liquid lymph, were made on the eighth day thereafter, all of which succeeded, as well as two of the punctures, which had been made in the first instance.² We have, in our own practice, seen the effects delayed as late as the ninth day, owing, as we thought,

¹ Jenner's *Facts and Obs.*, pp. 137 and 170.

² *Brit. and For. Med. Rev.* No. xv, p. 262.

to some constitutional peculiarity ; and Heim assigns the same cause. By other German physicians, this retardation has been attributed to cold weather. But however this may be, in some countries, and in certain seasons, the difficulty of conveying Cow-pock by inoculation has been so great, and so general, (at Turin, for instance, in 1829), that we must admit with Griva, Howison,¹ and others, the influence of a peculiar condition of the atmosphere. The effects of the Sirocco, and of other hot winds, in interfering with the process, are well attested.

It appears, even from the statistics of the continental physicians, which have been one principal cause of exciting distrust in the public mind, as to the real efficacy of Cow-pock, that about one-half of all the persons, who have been subjected to its influence, are proof against the effects of Revaccination. Hence it might be reasonably inferred, that the consecutive liability of the other half depends on some irregularity in the primary operation ; and without assigning this, in accordance with Dr. Baron, as the sole cause of failure, no doubt it is so in a very considerable number of instances. But it has been well established, that, independently of any imperfection in the lymph, or in the mode of applying it, a certain undetermined proportion of the vaccinated again become susceptible of the variolous contagion ; and it is therefore a question of great importance, but of great difficulty also, to determine on what this consecutive liability depends. By some, it is explained as a mere exception to the general rule, and as analogous to the secondary occurrence of Small-pox in individuals, who have already passed through the disease in its natural form ; and this, no doubt, is the true explanation, to a certain extent. Another mode of accounting for consecutive susceptibility of the contagion, is by supposing, that the vaccine vesicle, whilst apparently passing with due regularity through all its stages, fails, from some inappreciable causes, in imparting its genuine influence to the system, which is therefore only seemingly, but not, at any time, really protected.

A third explanation is, that the protection imparted by Vaccination, even in the most perfect manner, wears out in process of time.²

Heim expressly asserts, as the result of his extended experience, that the number of persons liable to secondary attacks of Small-pox is increased in proportion to the lapse of time from the primary operation, and endeavours to account for this renewed liability, by supposing, that even after a perfect Vaccination, a portion of the susceptibility has been left unextinguished, which is possibly beyond the reach of the protecting powers of the lymph.³ Wendt also observed, that cases of secondary variola were milder, according as the patient was younger, and therefore concluded, that the protective power was really diminished after the expiry of many years.⁴ This opinion, however, is not, by any means, confined solely to the physicians of Wirtemberg, and other continental states ; for Burns, many years before the observations of Heim were published, had expressly stated, that the liability to a second attack of Small-pox increases in proportion as we recede from the date of the first Vaccination, and augment the activity of the infection ;⁵ and

¹ Med. Gaz., vol. viii.

² Mr. Brown in Med.-Chir. Trans., Vol. xii, p. 336.

³ Brit. and For. Med. Rev., No. ix.

⁴ No. xiii.

⁵ The Principles of Midwifery. Sixth Edition. London : 1824.

Spooner,¹ very recently, has advocated the practice of Revaccination on the same ground. Dr. Alison, also, whose caution and precision in drawing his conclusions, render his opinions of the highest authority, expresses his view of the subject in the following terms :

"The most important question in regard to this mitigated form of Small-pox is, whether it is more apt to occur, or approaches nearer to the natural disease, in those vaccinated long previously : and the fairest conclusion that can be drawn from the facts hitherto ascertained is, that, if not occurring more frequently, it is oftener severe in those long previously vaccinated, than in others ; whence it may be inferred, that when the disease is prevalent, Revaccination may be an effectual preventive as to some who might otherwise be affected."²

Many accurate observers, on the other hand, are of opinion, that distance of time impresses no modification on the anti-variola power of Cow-pock, which is alleged to resist the contagion equally at all periods of after-life ; and it is further urged, that if a secondary attack of Small-pox actually becomes developed, the symptoms are alike modified, whether the primary operation has preceded its appearance by some years, or only by a few days. And certainly this view of the case is more in consonance with the law, which seems to regulate other diseases occurring only once during life ; for the protective effects of measles and scarlatina are not known to suffer any diminution by lapse of time.

It is pretty evident, therefore, that renewed and extended observations are necessary to determine, at all accurately, the proportion of secondary attacks, which should be assigned to each of the alleged causes which have been passed in review. But to whatever it may be attributed, the fact cannot be disputed, that Small-pox unquestionably occurs after Vaccination, and, as it is alleged, with increased frequency of late years. The actual amount of such cases has, however, in our opinion, been greatly exaggerated, and the fatality of the epidemic, even in the places which it has most severely visited in these kingdoms, is in no degree to be compared to that of the epidemics of an earlier date, before the introduction of Cow-pock. And if from the entire number of deaths, which have occurred, we deduct those fairly attributable to the total neglect, or the imperfect performance of Vaccination, as well as those occurring in constitutions absolutely insusceptible of protection, the remainder, supervening after the perfect progress of Cow-pock through the system, will, I apprehend, be found to be extremely small. Within my own sphere of observation, the occurrence of Small-pox, especially in the unmodified form, after genuine Vaccination, has been very rare ; and Baron, whose opinion on this subject is not lightly to be controverted, alleges, that the cases of Small-pox occurring after Vaccination, are not more numerous than those occurring after a previous attack of Small-pox, and consequently, it may reasonably be presumed, after Variolous Inoculation. On this point, we think, the practical question in a great measure turns ; for if it can be conclusively shewn, that Vaccination, confessedly preferable, in point of mildness and safety, to either the casual or inoculated disease, confers an equal degree of exemption from a se-

¹ Prov. Med. and Surg. Journ., July 1850.

² Alison's Outlines of Pathology and Practice of Medicine. Part ii, pp. 475-6.

condary attack, no farther room would remain for controversy. For it is not reasonably to be expected, that Cow-pock, formerly believed, and more recently proved, to be in itself only a modified form of Small-pox, should impart any greater amount of protection than the more severe forms of the malady.

The view of Baron, just alluded to, is, however, opposed by various authorities,¹ and it must be conceded, that data do not exist which enable us to arrive at a definitive conclusion; but, reasoning from analogy, now that the identity of the different forms of the disease has been established, the fair inference appears to be, that the immunity afforded should be in each case the same. But, even if we were to admit consecutive attacks of Small-pox to be more frequent after Vaccination, at the present time, than after the casual disease, there are good grounds for believing, that they could, at all events, be reduced within the same limits, by the more perfect and careful performance of the operation. For, without totally denying the influence of other agencies, I think there is sufficient statistical information to shew, that by far the most influential cause of the renewed frequency of Small-pox, is the total neglect, or imperfect performance of Vaccination; a fact which, if fully brought before the public, appears highly calculated to restore their confidence in the preventive efficacy of Cow-pock.

But whatever may be the comparative frequency of secondary attacks, after Vaccination and Small-pox, it is certain, that the mortality is much less after the former than the latter, and infinitely below that occurring in cases totally unprotected by the previous occurrence of the disease in any form. To illustrate: of 556 cases of Small-pox which fell under the observation of Dr. John Thomson,² in 205 the disease was primary, and of these 50 died, or rather more than 1 in 4; 71 had previously had natural Small-pox, and of these 3 died, or 1 in about 23. The remaining 310 patients had been vaccinated, and only one case proved fatal! Again, of 419 patients admitted in 1825 into the London Small-pox Hospital, 263 were unprotected, and of these 107 died; of two previously inoculated with Small-pox, one died; whilst of 147 who had been previously vaccinated, death occurred in 12. Such a rate of mortality as this last, although still very much in favour of the comparative safety of Vaccination, is higher than in any other recorded instance. But it afterwards appeared, that only one of the twelve patients alluded to, was proved to have been efficiently vaccinated; and therefore the unfavourable opinion, deducible from the original report, must fall to the ground.

Out of a large mass of statistics illustrative of the same point, the following facts, referred to in Dr. Watson's admirable *Lectures on the Principles and Practice of Physic*,³ appear conclusive. Of the population of Marseilles in 1828, among the 30,000 vaccinated, about 2,000 were attacked with Small-pox, and 20 perished, or 1 in 100. Of 8,000 unprotected, 4,000 were attacked, and 1,000, or 1 in every 4, died. And out of the 2,000 variolated, 20 took the disease a second time, and 4 died, or 1 in 5. On reading these details, the immense value of

¹ British and Foreign Medical Review. No. xii, p. 494.

² On Varioloid Diseases.

³ Third Edition, p. 798.

Cow-pock in saving human life is irresistibly forced upon us. Yet a charge of an opposite tendency has been made against the practice, to which it is merely necessary to advert. Many years ago, it was apparently demonstrated by Dr. Watt, of Glasgow,¹ that the effect of Vaccination was to increase the other diseases, and consequently the mortality of infancy; but this view was subsequently shown, by the researches of Robertson and Cowan, to be based on erroneous statistics, and it has, we believe, been long entirely exploded. But we must now proceed to examine the measures, which have been suggested, to remedy the admitted failure of Vaccination to a certain extent.

III. REMEDIES WHICH HAVE BEEN SUGGESTED TO OBLVIATE PARTIAL FAILURE OF VACCINATION—VARIOLOUS INOCULATION—EMPLOYMENT OF LYMPH TAKEN AFRESH FROM THE COW INSTEAD OF THE STOCK IN GENERAL USE—INCREASED NUMBER OF THE VESICLES—THE UNIVERSAL ADOPTION AND MORE CAREFUL PERFORMANCE OF VACCINATION AND REVACCINATION UNDER PECULIAR CIRCUMSTANCES, AND AT SUITABLE INTERVALS.

a. Return to Variolous Inoculation. A few writers recommend that Vaccination should be relinquished for Variolous Inoculation, and others have proposed that the latter should be performed in all cases after the former, at once in proof and in aid of its efficiency. In point of mildness and safety, as is universally known, no comparison can be instituted between the two resulting forms of disease, and the subject for practical consideration is, therefore, not only whether the protective influence of inoculated Small-pox is greater than that of Cow-pock, but so much greater, as to render it advisable, or even prudent to abandon Vaccination altogether, or at least to test or aid its effects, in every case, by subsequently inserting the Small-pox virus.

Before adopting any change in our practice in this respect, it is incumbent on those, who advise the alteration, to enforce their views, not only by a general expression of their opinion, but reasonably to demonstrate by a reference to accredited facts—for no general expression of belief will suffice—not only, that the number of attacks, but also the number of deaths, from Small-pox secondary to Vaccination, is greater, in any given number of cases, than in Small-pox secondary to the variolous disease, whether casual or inoculated. Neither will the statement of bare results be conclusive, unless accompanied by reasonable proof that the primary Cow-pock was perfectly efficient and regular; for it is obvious, that any inferences unfavourable to Vaccination, as far as they are drawn from its imperfect performance, are thereby vitiated, and useless in determining the true value of the operation. It therefore becomes necessary to examine somewhat closely the evidence on this head. From the almost general abandonment of Variolous Inoculation in the present century, little statistical information can be adduced in illustration of its comparative efficacy; but there is quite enough to shew, that the assumption of complete immunity being thereby afforded in after life, is totally opposed to the facts of the case. It may also be reasonably presumed, that the inoculated is, at the utmost, not a more powerful prophylactic than the natural form of Small-pox. Yet it is now fully established, that

¹ Edin. Med. and Surg. Journ., vol. x; and Maunsell and Evanson on the Diseases of Children. first edition. p. 440.

the occurrence of a secondary attack, after the latter, is anything but an unusual occurrence ; and the researches of Thomson, Bryce, Mohl, and others, may be adduced, as shewing that its modifying influence is actually inferior to that of Vaccination.

We have already pointed out, that it is quite erroneous to suppose that Variolous Inoculation confers any certain exemption from a consecutive attack of the natural disease ; and this is proved by facts of the following kind. In the records of the London Small-pox Hospital, before referred to, of two cases of Small-pox, known to have occurred after Inoculation, one proved fatal ; and at least one other person died of a secondary attack in Norwich, in 1819, and many other instances of the same kind might be adduced. Certain writers, moreover, affirm, that a subsequent attack of Small-pox is much less frequent after the casual, than after the inoculated disease. According to the conclusions drawn from the London Bills of Mortality by Jurin, to which we have already alluded, as quoted by Dr. Baron in his *Life of Jenner*, death occurred in the proportion of one in every fifty of the Inoculated.

At the utmost, therefore, we think it questionable, whether the protection capable of being conferred by the practice of Inoculation, would exceed that afforded by Vaccination, if universally carried out in the most perfect form of which it is capable. And in estimating, generally, the comparative advantages of the two plans, we must keep steadily in view the greater severity of the symptoms, and the much higher ratio of deaths, directly resulting from the operation, in the case of Inoculated Small-pox, as well as its inevitable tendency to increase the absolute mortality by the diffusion of contagion. This last consideration alone, as affecting the general welfare, is worthy of the most mature consideration ; for, conceding that successful precautions might be taken to prevent the spread of the disease, under particular circumstances, it is easy to foresee, that the practice of general Inoculation, from a variety of causes, would again be followed by a great increase of the natural disease, as in former times, when the total mortality from this cause, as shown by Heberden, was swelled from 7·4 to 9·5 per cent. It is also instructive to contrast the diminished mortality, arising from Small-pox, at the present day, with that occurring before the discovery of Vaccination ; for it appears that, even after Variolous Inoculation was in general operation, 1 in 14 of all persons born, died of Small-pox.

It has been a question, whether the entire prohibition of Variolous Inoculation by law is a desirable measure ; but, strongly as we are opposed to the resumption of the operation as a general practice, we agree with several previous writers in the belief, that a positive enactment on this head is neither desirable or necessary. Particular instances may occur, as in the outbreak of Small-pox in a ship at sea, in which anticipation of the natural disease, by the artificial method, would certainly be followed by a great saving of human life ; and we think that the circumstances under which Inoculation may be beneficially resorted to, may be safely left to the determination of the medical profession, who have already decided against it as a general practice. But the total prohibition of Inoculation by the hands of the ignorant and unqualified, is but a simple act of justice to the general community ; the more especially, as the inoculated disease, even when occurring in its mildest shape, is capable of

diffusing the infection in the most severe and deadly forms. With such facts as the following before them, capable of being swelled to a long and sad catalogue, but which we have selected as the most recent, it is surely time for the legislature and the executive to interpose in an effectual manner. At St. Thomas's, East Budleigh, Devonshire, eleven individuals died of Small-pox, which had been propagated by persons opposed to Vaccination, and who *had inoculated not only their own families, but those of their neighbours*.¹ Facts like these fully justify the strong condemnation of so barbarous and fatal a practice, contained in the Report of the Vaccine Section of the Provincial Medical and Surgical Association of 1839, and the recommendation that it should be invariably superseded by Vaccination.

b. Renewal of Lymph, by taking it afresh from the Cow, for the purpose of Vaccination. It has been asserted, but by no means satisfactorily demonstrated, that lymph, taken directly from the cow, is more effective than the stock which has been so long in use, and which has been alleged to become weakened by transmission through numerous subjects. The testimony on this point is, however, discrepant. Many believe that there is little or no difference between the effects of the old and new virus; whilst in the hands of Mr. Estlin,² and some other English practitioners, the results have been apparently favourable to the fresh stock. That form of lymph, obtained by Mr. Ceely from direct inoculation of the cow with the Small-pox, has been found to act successfully and energetically in reproducing the vesicle in man; but whether it shall be superior to that in general use, can only be decided by extended experience. That a deteriorated form of virus, yet capable of transmission, may be produced by carelessness or want of skill, I think there is no reason to doubt, even if it had not been proved by the researches and experiments of the late Dr. John Thomson, of Edinburgh; but, provided all the directions of Jenner be adhered to, in which case only it is fair to judge, I have seen no just grounds for concluding, that the genuine vaccine vesicle, in appearance, progress, and effect, is not precisely the same that it was in his day. It appears, however, that more severe constitutional symptoms are produced by lymph taken directly from the cow; and those who hold that febrile irritation is a measure of the due effect of the virus on the system, will, of course, give it the preference. But many competent observers have adjudged the superiority to the human lymph, as more mild, equally sure, and, at the same time, entailing fewer accidents. Still, various circumstances may render it necessary to draw a fresh supply of virus from the cow; but in so doing, it is a matter of the first consequence, in order to ensure protection to the vaccinated, that the most accurate distinction shall be made between the genuine pock in that animal and the spurious forms of the disease, which caused so much embarrassment to Jenner, and which might still lead to a variety of false conclusions respecting the real value of Vaccination. The best practical rule to guide the less experienced in such matters, will be, to reject all forms of the pock

¹ Report of the Registrar-General.

² See a paper read before the Medical Section of the British Association, "On the New Vaccine Virus"; and another "On the Cause of the Increase of Small-pox, and the Origin of Variola Vaccina", by Dr. Inglis, in 1839.

which appear the least doubtful, and extract the lymph only from such as correspond closely with the symptoms of the genuine disease, which, principally to this end, the reader will find minutely described at a former page. The necessity for this precaution will appear, from a statement made by Heim, that there are no less than eight forms of Cow-pock. Of these, three, described as Viborg's wart or stone pock, the white eruption of Thär, and the wind-pock, are incommunicable to man. The five varieties capable of transmission to the human system are, the amber-pock of Nissen, the black-pock of Nissen, the bluish-pock, the white-pock, and the red-pock. Of the spurious forms of disease, the white-pock is perhaps the most common source of error ; as it sometimes exhibits a well defined vesicle, a pink areola, and even the central depression ; but its true nature may be detected on close examination, as it is destitute of two of the most striking characteristics of the genuine vesicle, namely, the presence of a fluid lymph, and the cellular structure. The distinction will be more evident in other forms of the spurious disease, presenting the appearance of reddish pustules, containing a yellow humour ; mere vesicles containing a viscid, or watery fluid ; a miliary eruption, characterised by the rapidity of its progress, and terminating variously in different forms of corroding ulcer ; or warty induration. The subject is rendered still more embarrassing by the fact, that the true and false diseases may be prevalent at the same time, and even co-exist in the same animal. Jenner (by whom the bastard forms of pock were classed together, under the appellation of spurious cow-pock) pointed out, as broad distinguishing marks, their freedom from all bluish, or livid tints, and their property of desiccating quickly, without producing any constitutional disorder.

We have not space here to enter more fully into detail ; but ample information, on the disease in the cow, will be found in the works of Jenner, Ceely, Heim, Hering, Prinz, Thiele, and other writers, who have expressly investigated the subject.¹ But from the great variety of affections in the cow, and the rare opportunities afforded to most physicians of acquiring an adequate practical knowledge of the subject, the more prudent plan, supposing at any time we may deem it expedient to renew our supply of lymph, will be to produce the disease in that animal, for the express purpose, by Variolous Inoculation. And in all cases, without exception, where the resulting phenomena, after vaccinating directly from the cow, do not appear to be perfectly regular, we should revaccinate the patients, and cease to employ the lymph for the further transmission of the malady.

But neither the casual, nor the inoculated disease in the cow, is the sole source of vaccine virus ; for lymph may be procured, although with some difficulty, by the practice of Retrovaccination, or the artificial communication of Cow-pock to that animal, from the human subject. The experiments of M. Fiard, and the scepticism of Gregory on this point, have already been glanced at ; but the conclusive and beautiful experiments of Mr. Ceely have subsequently put the matter

¹ See also Brit. and For. Med. Rev., No. xiii, p. 190 ; and No. xvii, p. 95. Trans. Brit. and For. Med. Ass., Vol. viii, 1840.

beyond doubt, and farther shewn that the vaccine lymph, thus procured, may again be transmitted with success to the human system. It is worthy of remark, however, that when thus employed, the resulting vesicle is smaller than usual, and does not reach its acme till the eleventh, twelfth, or thirteenth day; recovering, however, after two or three removes from the cow, its usual characteristics¹. It is contended by Prinz, that this process of Retrovaccination has the effect of renewing the efficiency of the lymph, supposed to be impaired by repeated transmission through the human subject; but, even if this deterioration were admitted as a fact, it does not appear how the process could restore its efficacy. Practically speaking, the only useful object of Retrovaccination is to increase the supply of vaccine matter; for though some have argued that its quality is improved, and others, that it is deteriorated by this process, to us it appears that it would just be possessed of the same qualities, and be neither better, nor worse, for its retransmission through the cow.² Where it is desired to experiment on the subject, genuine vaccine lymph, taken fresh from the arm, should be freely applied to the teats and udder of a young animal. The spring is said to be the best season for performing the operation.

It may here be mentioned that, in describing certain peculiarities of the disease in the cow, Ceely³ details some very interesting circumstances, which render it extremely probable that the Cow-pock, in one instance, had its origin in several of those animals from variolous effluvia.

c. Increased Number of Vesicles. We have already adverted to this point, and shall here only point attention to the conclusions of M. Delfraysse, contained in a note addressed to the Academy of Medicine of Paris, as the most recent promulgation of opinion that has fallen under our notice. The French writer expresses his conviction, that Vaccination is an infallible preventive, where the vesicles are sufficiently numerous to produce a degree of febrile reaction; and that its failure is attributable, as Heim has maintained before him, to the absence, or insufficient development of this febrile affection. He therefore recommends from twenty to thirty punctures, to be made in each case, in different parts of the body.⁴ M. Delfraysse, in proof of his doctrine, alleges that all his patients, thus vaccinated, have resisted the influence of variolous contagion. No doubt they have: and so also have innumerable persons, protected only by two or three vesicles. But we do not maintain that a large number of punctures are ineffectual, but simply that they are cruel, inconvenient, and superfluous. We admit that thirty vesicles cannot be raised, on different parts of the surface, in any case, without producing symptomatic fever; but we question the advantage of the practice; and it evidently leads to embarrassment, as it does not appear possible to distinguish the constitutional disturbance, excited by so many wounds, from the

¹ See Brit. and For. Med. Rev.; and Dublin Med. Press, Aug. 1839.

² See Brit. and For. Med. Rev. No. xvii, p. 85.

³ Mr. Ceely in Trans. of the Provincial Med. and Surg. Association, vol. x, p. 354; also, Brit. and For. Med. Rev., No. xxviii, p. 398.

⁴ Dublin Medical Press, Nov. 6, 1850, p. 294.

specific febrile irritation, resulting from the effects of the vaccine virus on the constitution. And, further, if the doctrine of M. Delfrayse were true, Revaccination should succeed not in one half, but in the entire number of cases exposed to its operation. On the whole, we confess our scepticism as to the plan being either judicious, or necessary.

d. Vaccination and Revaccination. Little importance can fairly be attached to renewal of the lymph, or to the employment of a great number of punctures, as means of increasing the defensive efficacy of Cow-pock; and Variolous Inoculation has not only been shewn to be a dangerous and ineligible substitute for Vaccination, but its actual superiority, as a protective, may be fairly questioned. Cow-pock is admitted, on all hands, to confer immunity from Small-pox, in the vast majority of instances; and any additional security to be hoped for will probably be found, if due means shall be taken to ensure the universal and careful practice of Vaccination, aided by Revaccination, under peculiar circumstances, and at suitable intervals.

How efficacious the measures advocated would prove, may be clearly shewn, by contrasting the following table of results, occurring amongst the British troops, where Vaccination is duly attended to, with what is known to occur amongst the civil population, from the culpable and reckless disregard of the means of safety too frequently exhibited.

TABLE, compiled from the official "Statistical Reports", for twenty years, commencing in 1817, and ending in 1836.

	Aggregate Strength.	Total Mortality.	Deaths from Small-pox.
Dragoon Regiments and Guards	44,611 ...	627 ...	3
Troops at Gibraltar	60,269 ...	1,291 ...	1
In West Indies, where Small-pox was several times epidemic	86,661 ...	6,803 ...	0
Black troops	40,934 ...	1,645 ...	0
In Malta, for 19 years, where Small-pox raged as an epidemic, and destroyed 1,169 persons	40,826 ...	665 ...	2
In Ceylon, where above 3,000 of the natives died of the epidemic in 1819, 1830, 1834, White troops	— ...	3,000 ...	4
Malay troops	— ...	853 ...	9
Pioneer corps	— ...	647 ...	1

Similar results were observed in India, and other British colonies;¹ and I think it would be impossible to adduce any stronger, or more convincing practical argument, in favour of the high degree of protective power exerted by Vaccination. After reading it, we may truly adopt the conclusion of Dr. Watson, "Where Vaccination is, the contagion of Small-pox need never come."

The conditions of the lymph, and of the system, necessary to the successful transmission of Cow-pock, have already been discussed at full length; but it remains to say a few words as to the most effective manner of performing the operation. This, in itself, is by no means difficult; but considerable skill, and due attention, are necessary, not only to determine the genuine characteristics of the vesicle, but to decide, whether it shall have gone regularly through all its stages, and

¹ Watson's Lectures, third edition, vol. ii, p. 799.

imparted its full protective influence to the system. Hence, in Germany, the physicians and surgeons are alone allowed to operate; and a similar regulation might be adopted in these countries with great advantage. Few physicians think it necessary to employ any preparatory treatment; but the use of a gentle aperient, as recommended by Ryan, cannot, at all events, do any harm. The operation itself is done variously. Some recommend a clean, and some a blunt lancet to be used. One surgeon advises a single puncture to be made in each arm, another three or four, and a third as many as thirty, whilst a fourth prefers longitudinal scratches to punctures. Capuron says, the less painful the puncture, the better characterised will the pock be; and Elliotson advises the lancet to be so held, that the matter may gravitate into the wound. Cazenave and Schedel, on the contrary, direct the instrument to be introduced horizontally; and they object to incision as being less sure than puncture, by causing a flow of blood, and thereby diluting the lymph. Now all this rather savours of the foppery of science. Vaccination may be perfectly well performed either by puncture or incision; and he must be a very coarse operator indeed, who shall wound the arm in such a manner as to produce any serious degree of irritation. This may, doubtless, arise in peculiar constitutions, after any mode of operating; and it is very likely to occur, when the cruel and unnecessary plan of creating a great number of punctures is resorted to. The objection, founded on the dilution of the lymph by the flow of blood, we hold to be purely theoretical, and not based on accurate observation. At one period, I had considerable experience on this point, having vaccinated as many as one hundred and eighty individuals in a single day, and most of them successfully; but it never appeared, that the results were affected by the degree of hæmorrhage, which depends rather on the constitution of the child, than the want of dexterity of the operator. We may naturally expect an infant of full habit to bleed freely; and the actual state of the matter appears to be correctly expressed by Dr. Gregory, when he says, that provided genuine lymph has come in contact with the absorbing surface of the cutis vera, it is no matter whether little or much blood flows.

The plan which I adopt in my own practice, is to render tense the skin of the arm to be operated on, by gently grasping it in the left hand, and then to carefully make a few slight scratches with the point of the lancet, previously charged with fresh fluid lymph, on three different points, at the distance of about an inch apart, so as to guard against the possibility of the vesicles running into each other. The lancet should be immersed anew in the lymph after making the scarifications, and gently drawn over the wounds, to transfer to them the matter as completely as possible. The same manipulation should be repeated at each point operated on. This mode I have rarely found to fail, except where constitutional insusceptibility of the infection was present.

For the convenience both of the child and nurse, the more convenient plan is to vaccinate only one arm, as the vesicles can thus be much better defended from accidental injury and irritation. The object in making three punctures is two-fold; first, to multiply the

chances of success in the operation ; and in the second place, to provide a supply of lymph, for transmission, without disturbing all the vesicles ; and not from any belief that twenty punctures would more certainly impart protection to the system than one. At any rate, analogy is in favour of this view of the case ; for the casual small-pox appears to protect equally, whether the pustules be many, or few. Of course, where liquid virus cannot be procured, after making the necessary scratches with the lancet, the dry lymph should be effectually rubbed into them. The child's dress should be carefully adjusted, so as to prevent contact with the arm until the wounds are dry, and friction must be sedulously guarded against, as soon as the vesicles begin to form. Examination of the patient, at due intervals, afterwards, especially on the fifth, eighth, and tenth days, is indispensable, to ascertain that the progress of the disease is perfectly regular.

The most eligible age for Vaccination has already been pointed out ; but we should not delay to operate at any time, where the infant is either likely to be exposed, or has already been exposed, to the contagion of the natural disease, taking the chance that the milder may anticipate, and possibly prevent, or at all events modify, the more malignant malady. With reference to this part of the subject, we shall introduce some of the results observed in such cases, as well as certain experiments which have been instituted with the Small-pox and vaccine lymphs.¹

Where the variolous and Cow-pock virus are inserted on the same day, each malady may pursue its course unaltered, with considerable constitutional disturbance; or they may be mutually modified by their influence on each other, the Small-pox being greatly mitigated, and the eruption either proving abortive, or terminating in imperfect hard shining pustules, called horn-pock, stone-pock, or swine-pock (*variola verrucosæ*).

Where Vaccination precedes Inoculation by a period not exceeding four days, the local diseases advance together, but the Small-pox may or may not be accompanied by a general eruption, and the constitutional symptoms may be very slight. In such cases, the vaccine lymph retains its peculiar properties; but more frequently it is contaminated by the variolous virus, and consequently it should not be used for the transmission of the disease.

Variolous matter will affect the system more or less severely, where Inoculation is practised anterior to the seventh day from the period of Vaccination, but subsequently it will produce no effect.

Inoculation with Vaccine and Small-pox matter mixed, is sometimes followed by Cow-pock, and sometimes by Small-pox ; and if the two forms of lymph be introduced at the same time, at separate points, but near enough to permit the vesicles to unite, the virus thence taken shall in one case produce Cow-pock, and in another Small-pox.

From observing some fatal cases, occurring in infants coterminously affected with Cow-pock and Small-pox at the Children's

¹ Willan on Vaccine Inoculation. 1806.

Hospital of Paris, it was believed by MM. Rilliet, Barthez, and Legendre, that Vaccination exerted an unfavourable effect; an opinion controverted by M. Herard, who came to the conclusion, consonant with general experience, that when the two eruptions are developed together, the variola is advantageously modified, but less so in an unhealthy than a healthy child. And he adds, very justly in our opinion, that the danger in such cases arises from the Small-pox and not from the Vaccination, which should, as at least innocent, be practised in all cases.¹ This is judicious advice, at all events, although it may frequently fail to produce the desired results; and it is scarcely necessary to say, that the previous directions, regarding the mode and period of selecting the lymph, and the health of the patient at the time of operating, should be strictly attended to. In leaving this part of the subject, we may be permitted to express our conviction, that Vaccination, if universally carried into effect, with all the precautions alluded to, would be found at once the safest and most efficient means within the reach of human power, to arrest the ravages of Small-pox. At any rate, its superiority over Inoculation, in diminishing the absolute mortality from that disease, is strongly illustrated by the following results, deduced from the tables of Sir Gilbert Blane.

In the fifteen years immediately preceding the introduction of variolous Inoculation, the mortality arising from Small-pox amounted to 78 in every 1000 deaths from all causes; in the next thirty years, when Inoculation was in use, the ratio was about 90 to 1000; and in the following fifteen years, after the introduction of Vaccination, the mortality was reduced to 53 in 1000.² Were it not superfluous, we might farther refer to the vast saving of human life, consequent on the introduction of Cow-pock into Sweden and Prussia.³

But admitting that the most perfect Vaccination does not render all persons proof against the subsequent effects, either of the casual contagion of Small-pox, or of variolous or vaccine Inoculation, we are not thence to infer, that the practice is less efficacious now than it was at the earlier period of its history; but simply that Jenner overrated its power, in alleging that it extended complete protection to all who submitted to the operation; for it is now well known that, in many constitutions, the susceptibility is so strong as to be absolutely beyond the protective influence of the variolo-vaccine virus in any shape. The class of persons alluded to we believe to be greatly more numerous than has been commonly supposed, in proof of which it may be stated, that in the experiments of Heim, Vaccination, practised after Small-pox so severe as to leave the patients marked with scars, *succeeded in more than half the cases*; a result nearly analogous to the effects of Vaccination after Cow-pock.

With reference to Revaccination, the practical questions which we are called on to decide are these: Is it necessary or desirable, for the purpose of protecting the system from the contagion of Small-pox, to revaccinate, where the primary operation has been effectively per-

¹ L'Union Médicale, and Med. Chir. Rev., 1849, quoted in Monthly Retrospect, ann. eodem, p. 158.

² Med. Chir. Trans., vol. x. ³ Ed. Med. and Surg. Trans., vol. xxvi, p. 171.

formed ? and if so, how often and at what periods of time ? For there cannot of course be any doubt as to the propriety of a second Vaccination, where the process has either partially or completely failed, in the first instance, either from imperfection in the lymph employed, or from the existence of some cotemporaneous disease, or constitutional peculiarity in the patient. It was announced by Jenner himself, that the system, after a time, has its susceptibility of Cow-pock renewed, a position subsequently demonstrated by the observations made in Wirtemberg and elsewhere. Thus of 275 Revaccinations, in the Danish army, recounted by Wendt, considerably more than one-half succeeded, and it were easy to adduce a mass of statistics of a similar tenor. Indeed, the fact seems now incontrovertible ; but, admitting it to be so, the practical utility of Revaccination has been questioned, on the grounds of want of proof, that revaccinated individuals are less susceptible of Small-pox, than those who have only once undergone the operation. And it is evident, that the argument for Revaccination, so far as it relies on the statistics referred to, assumes that the receptivity of the artificial, implies an equal receptivity of the natural disease, or in other words, that all persons in whom the secondary operation succeeds, would be liable to an attack of Small-pox, if casually exposed to the contagion. And it is expressly on this ground that the practice of Revaccination has been advocated by Wendt, Heim, and several other writers. But this assumption, although countenanced by the identity of the different forms of the disease, has not been satisfactorily demonstrated by a sufficient body of statistical data ; and ample proof will be required to establish for it the character of a law in the disease.

One mode of accounting for consecutive susceptibility of Cow-pock, rests on the assumption, that the effects of the primary operation on the system wear out by lapse of time ; and the statistics of the German physicians have been relied on, as the chief means of demonstrating this point. But too much stress, in this respect, appears to have been laid on the facts which they have brought forward ; for, on referring to the details, it will be found, that in one-half of all the cases enumerated, the system was perfectly proof against the infection, and Revaccination entirely failed. It is farther very material to observe, that this resistance of the contagious lymph exhibited itself, not merely amongst those who had recently undergone the primary Vaccination, but indiscriminately amongst all the patients operated on, who had been previously affected at any time by the Cow-pock virus. If, therefore, it be an inherent tendency in the protection conferred by Vaccination to wear out of the system by process of time, it may be fairly asked, why one-half of all the individuals operated on, should be an exception to the general rule. With reference to the question we are discussing, it is also particularly worthy of remark, that as far as the observations both of the Wirtemberg and Hanoverian physicians extended, the effects of Revaccination very closely approached each other, whether practised on those who had been previously vaccinated, or on those who had suffered from a primary attack of Small-pox in the natural way. In either case, about one-half resisted the influence of the vaccine virus either partially, or altogether, whilst the other half displayed the usual effects of the operation. Hence, it would appear, that if the protective

influence of Cow-pock really becomes extinguished in process of time, the immunity afforded by the casual, and *a fortiori* by the inoculated Small-pox, is of an equally temporary nature, an inference closely bearing on the comparative merits of Variolous Inoculation, and Vaccination. On the whole, however, the progressive extinction of the protective influence of Cow-pock may be gravely questioned, and a more reasonable explanation of the success of the German Revaccinations, may be founded on the two following considerations : 1st. That, in a considerable number of the cases detailed, the primary operation, from various causes, had not duly affected the system at all ; and 2dly. That, in a certain proportion of all individuals born, the most perfect impregnation with the variolo-vaccine infection, of which the constitution is susceptible, does not destroy the liability to be affected by the infection subsequently, more especially when directly introduced into the system, in a material form, by inoculation.

But the success of Revaccination is not the only argument advanced to show, that the effects of the primary operation gradually wear out of the system. Mr. Spooner and others, in proof of the same doctrine, assert, that the number and severity of the cases of secondary Small-pox, are increased in proportion to the length of time which has elapsed from Vaccination : and, if their belief were confirmed by a sufficient body of facts, the inference would be unquestionable ; but there is no sufficient statistical information, relative to the recurrence of Small-pox in the civil portion of the community of these kingdoms, to determine the question ; and the accurate military returns before referred to, point to conclusions very different from those of Mr. Spooner. So also do the reports of the Registrar-General ; for in an ably-written article, published by Dr. Stark in the *Edinburgh Medical and Surgical Journal*,¹ the fact, that four-fifths of all the deaths caused by Small-pox in some of the largest cities and towns in Great Britain occur in the first five years of life, is shown from the most authentic documents. This seems to militate strongly against the belief, that the protecting effects of Cowpock wear out by lapse of time ; for the period mentioned is precisely that in which the influence of Vaccination should be least impaired, and, consequently, in which the mortality of consecutive Small-pox should be lowest. But it has not only been alleged, that the protective influence wears out, but fixed periods, at which this is supposed to take place, have been defined.

According to Dr. Retzius of Stockholm, the protection remains undiminished from the close of the second to about the end of the thirteenth year, gradually losing its influence to the twenty-first year, after which period, the original liability to Small-pox recurs, and continues unimpaired to the age of forty years. Subsequently it approaches by degrees the limit of its existence, which it generally attains about the fiftieth year. Hence, his advice is to repeat the operation for Cow-pock, in about thirteen years.²

Wendt's opinion is, that the protecting power of a good Vaccination secures the system for a certain time, perhaps for six years, and he

¹ Vol. lxiv.

² Med.-Chir. Rev., July 1844.

admits also that a properly vaccinated person has always a milder form of the disease. As might be expected, he strongly recommends Revaccination; but he adds, at the same time, that the precise period for this, cannot be accurately determined, but must vary with the susceptibility of each individual for the Small-pox. Heim goes still further, asserting, that in very few instances was Revaccination entirely without effect, when performed five or six years after the first operation; whilst Spooner enlarges the period for successful Revaccination to fifteen or twenty years.

It is also a part of the evidence on this point, that where Revaccination does not produce any effect on the first trial, the operation should be repeated, as it will often succeed on a second attempt, although failing on the first. In proof of this, we may cite the statement of Schlesier, from which it appears that in about 14,000 unsuccessful cases, it succeeded in 1,569 on a second operation. According to Heim, the protective power of Revaccination extends to an equal time with the primary Vaccination, provided the success of the Revaccination be complete, and in no degree less perfect than the good Cow-pock of children; and that the vaccine virus be in sufficient quantity to saturate the system. Hence, it would appear, that if we were to adopt the views of Heim, the proper periods for Revaccination would be about every sixth year, during the entire period of life. Gregory assigns a longer period for the duration of the protective influence, extending, at least, to the tenth year.

But, whatever may be the true explanation, the secondary occurrence of Small-pox, in a certain number of cases, cannot be questioned any more than the fact that Revaccination succeeds to a considerable extent, and the practice may, therefore, be recommended on sound principles. There is much evidence to show that, in point of safety, the revaccinated are placed in the better position; and whether we subscribe to the theory of the progressive failure of the vaccine influence, or adopt the views, which in preference have just been advocated, it is impossible to say with certainty, in any given case, whether the system is truly protected or not. It may be added, that Revaccination is perfectly innocuous, and very rarely indeed productive of any serious results. In making this assertion, founded on the details of my own experience, I am aware, that in one case, related by Dr. Henry Kennedy, sloughing and alarming debility followed the operation;¹ but such instances are too rare, in a proper condition of health, to weigh at all against the practice, which at worst can only be useless, and may be legitimately defended, if its only effect were to save a single life, in thousands of cases. Influenced by these considerations, I have for many years recommended, and frequently performed the secondary operation as a measure at least prudent, if not absolutely necessary, and as being in no degree incompatible with the doctrines of Jenner.

With reference to the periods at which Revaccination should be performed, it appears that the opinions of different observers are too discrepant, to enable us to deduce from them any general rule of prac-

¹ Dublin Quarterly Journal, 1846.

tice. Five, seven, ten, fifteen and twenty years have been respectively assigned as the limit of the protective influence ; but, even granting that this limitation exists, it may reasonably be inferred, that the period at which the immunity becomes extinguished, varies with individual peculiarities of constitution. Were it, however, in the existing state of our information, considered eligible to revaccinate at stated periods, the more prudent plan would clearly be to adopt the shorter intervals. In my own practice, I have been guided rather by the wishes of patients and their friends, and the imminence of contagion, than by reference to the actual lapse of time. It is scarcely necessary to observe, that all the precautions respecting the choice of lymph, and the health of the patient, employed in the primary, are equally applicable to any consecutive Vaccination. And it may be further observed, that where Revaccination fails on a first attempt, the operation should be repeated, as it is impossible to decide, by a single trial, that the system is proof against the renewed application of the infection, as has been fully illustrated by the experience of Schlesier, to which we have already referred.

Such are the views, which after the most deliberate inquiry, and a reasonable share of practical acquaintance with the subject, I have been led to entertain, and to which I have considered it a duty to give currency ; being deeply impressed with the conviction, that *the efficient and general practice of Vaccination, aided by Revaccination, under suitable circumstances, will be found an efficient safeguard against the ravages of Small-pox, in all constitutions not absolutely beyond the influence of any protecting agent whatever.* And in this age of sanitary reform, it is a fact not very creditable to the good sense or intelligence of mankind, that a large proportion of all the children born, remain, in most countries, unvaccinated through the entire period of their lives. It evidently, therefore, becomes the duty of every member of society to contribute, as far as is in his power, to remedy a state of things, alike dangerous to the individual and to the community ; and each, in his degree, may contribute at least something to so desirable an end. As far as regards the legislature, it may be respectfully suggested, that a law to enforce universally the adoption of Vaccination might be justified on principles of the soundest policy ; but, even without any positive enactment on the subject, it is within the power of all governments to extend the practice in a very great degree. The bare knowledge of the fact, that the subject was considered of importance by the various branches of the executive, would do much ; and the object in view might be more fully accomplished, by bringing all the powers of both the common and statute law to bear against the practice of indiscriminate Variolous Inoculation, and by requiring proof of previous Vaccination, as a necessary condition to holding any situation or appointment, whatever, remunerated out of the public purse. Effectual means of enforcing the necessary regulations are evidently within the power of the directors of the army, navy, and East India Company, as well as the various police forces. The same may be said of the Customs and the Excise, and especially of the Poor Law Commissioners, and the

different boards of guardians throughout the realm, as the inmates of the poor-houses are mainly furnished from that class of the population, in which Vaccination is most likely to be performed carelessly, or neglected altogether. In private life, a great deal might be done to the same end, by the governors of hospitals and other charitable institutions, the masters of schools, the owners of merchant and emigrant vessels, and the proprietors of the great mills and manufactories of every description, throughout the country. The more intelligent classes of society, not content with having the operation performed in their own families, might materially promote the practice, by endeavouring to enlighten the ignorance, and overcome the obstinacy, still unhappily too prevalent amongst the uneducated, with reference to the subject. The benevolent offices of the ministers of religion might also be interposed with great effect; and tracts, couched in plain and forcible language, enforcing the practice of Vaccination as a Christian duty both to ourselves and others, if issued by the various societies for the promotion of knowledge, would, no doubt, be productive of the best results. Various other measures might be suggested; but what is especially required, is a full and universal recognition of the great practical importance of the subject; for if this be once attained, measures will speedily be found to carry out to completion the discovery of Jenner, which, even with the limitations imposed on it by our more extended knowledge, must always be looked on as one of the greatest blessings ever conferred on the human race.

RECAPITULATION. The most important practical deductions, suggested by a careful reconsideration of the whole subject, may be briefly embodied in the following recapitulation, which the writer begs leave earnestly to commend, with all due respect, to the consideration of his professional brethren. Should the views which he has advocated be found to contribute, in the slightest degree, to reassure the public confidence in the protective influence of Cow-pock, and to promote the more general and careful practice of Vaccination, his object will have been amply attained.

1. It appears to have been satisfactorily demonstrated, that secondary Vaccinations have succeeded in a considerable proportion of the cases, in which they have been resorted to.

2. It also appears, that Small-pox has prevailed of late years to an increased extent.

3. The results in question have been attributed, partly to a diminution of energy in the vaccine infection, caused by repeated transmission through the human subject, and partly to the alleged tendency of the immunity conferred by Cow-pock to wear out of the system, after an uncertain period from the date of Vaccination.

4. Both the success of Revaccination, and the increased prevalence of casual Small-pox, appear, however, to have been exaggerated in the popular belief; and, at any rate, the facts seem explicable, in a great measure, without resorting to the hypothesis just stated, by attributing them in part to the imperfect performance, or the entire neglect of Vaccination, in part to the temporary tendency to increased diffusion, at distant and uncertain periods of time, which characterizes all epi-

demic diseases, and, finally, to peculiarities of constitution, which render many individuals absolutely insusceptible of being protected against a secondary attack, either by Vaccination or by inoculated or natural Small-pox.

5. It has been proposed to re-introduce Variolous Inoculation as a certain remedy for the occasional failure of Vaccination, ; but the superior efficacy of the practice is not only questionable, but its indiscriminate employment has been proved to be dangerous, and destructive of human life, and is therefore highly to be deprecated.

6. Revaccination, however, may be prudently recommended, not only as innocuous in itself, but also, on various grounds, as positively advantageous, even by those who question the gradual extinction of the protective influence of Cow-pock.

7. It does not appear that genuine Vaccination has lost any of the efficacy, which at any time really appertained to it; and it still remains to be demonstrated that it is not capable of conferring, to the end of life, complete immunity from the horrors of Small-pox, on a large majority of all the individuals fully submitted to its influence.

8. Even where Vaccination fails to prevent a secondary attack, the consecutive disease, in general, assumes a mild and modified form, although, in some instances, it may be sufficiently severe to leave the countenance marked with scars, and still more rarely to terminate in death : but fatal cases from secondary Small-pox do not seem to be more frequent after Vaccination, than after a primary attack of the natural disease.

9. On the whole, it is respectfully maintained, that Cow-pock, imparted in the most efficient manner of which it is capable, by Vaccination, and, under certain circumstances, by Revaccination, is the most eligible safeguard, within our power, against Small-pox ; and that it will prove effectual in most constitutions, not inherently insusceptible of protection, by any means whatever.

Strangford, Ireland, October 1850.

P. S. Since the first part of this paper appeared in the November number, I regret to learn, on the best authority, that I have unintentionally fallen into an error regarding Dr. Gregory's views, in attributing to that distinguished physician (p. 1051) any change of opinion in consequence of the researches of Mr. Ceely. Dr. Gregory is still a believer in the non-identity of Cow-pock and Small-pox ; and I therefore take this, the earliest opportunity, of rectifying the mistake.

The reader is requested to correct the following

ERRATA.

Page 1042, lines 9 and 21, *for* British, *read* Provincial Medical and Surgical.

Page 1049, line 14, *omit the word* Retrovaccination.

Page 1050, line 5, *for* Cow-pock, *read* Small-pox.