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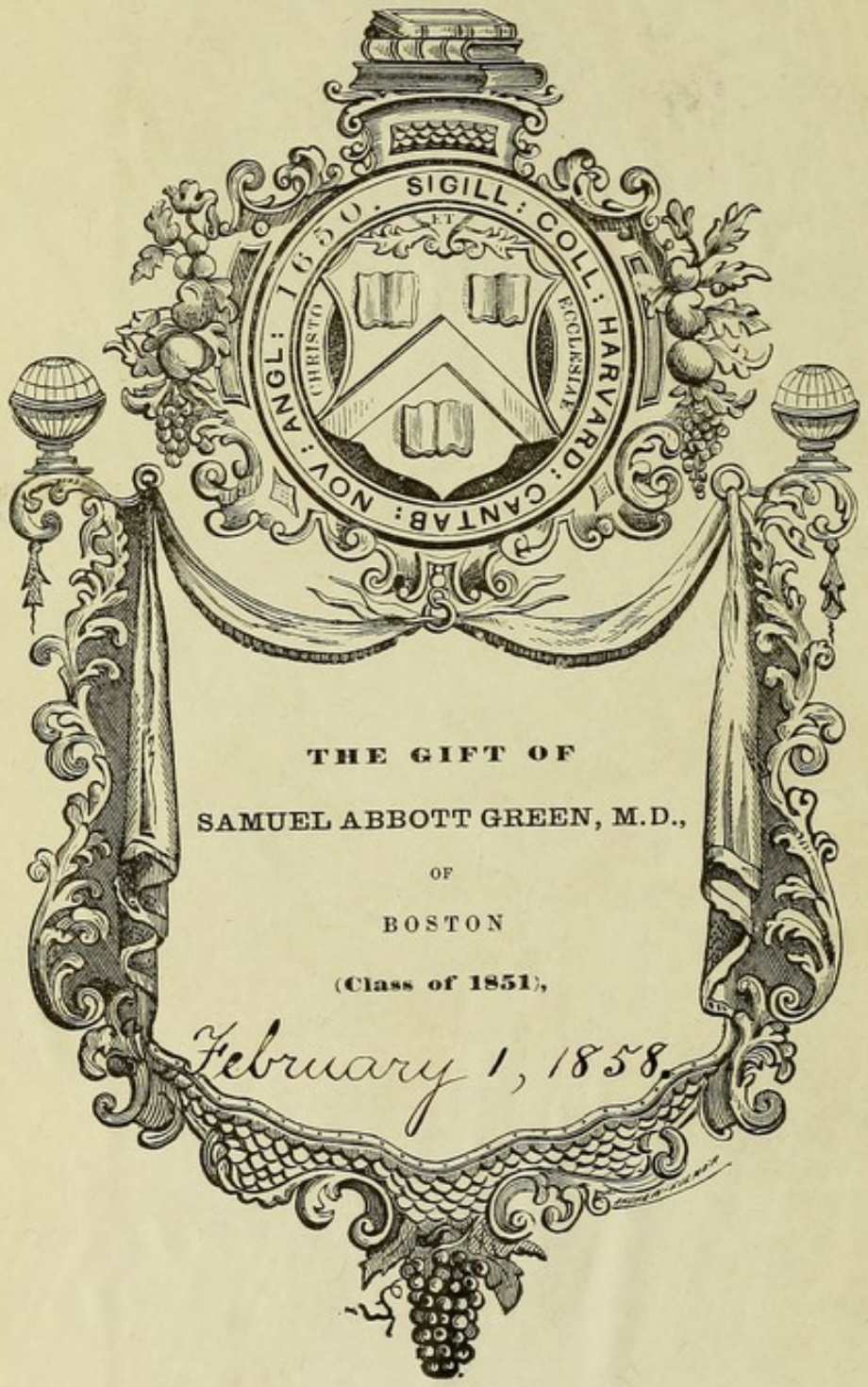

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BY

ALEXANDER KNOX, M.D.

PHYSICIAN TO THE STRANGFORD DISPENSARY.

London:

TAYLOR, WALTON, & MABERLY.

DUBLIN: MESSRS. HODGES & SMITH EDINBURGH: SUTHERLAND AND KNOX. BELFAST: LAMONT BROTHERS.

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

THE preventive influence of Vaccination, questioned even at the period of its discovery, and especially from the year 1804 onwards, has acquired additional claims to the most careful and dispassionate consideration, from the increased prevalence of epidemic Small-pox of late years. A re-examination of the subject, therefore, would appear peculiarly appropriate, not only with the object of attempting to satisfy the natural anxiety of the public, but also with the hope of contributing to a greater unanimity of professional opinion on the questions—*How far does the artificial Cow-pock actually secure the constitution against a subsequent attack of casual Small-pox?* and, *Whether it is possible, by any means, to confer an additional degree of security?*

To the examination of a subject, manifestly of the greatest practical importance, not only intrinsically, but as occurring to us almost daily in our professional life, I shall therefore address myself with all the deliberate attention and impartiality which the difficulty of the investigation properly demands.

1. CASUAL SMALL-POX—ITS HORRORS—PROPORTIONAL ATTACKS, AND MORTALITY—LEADING TO THE PRACTICE OF VARIOLOUS INOCULATION. HISTORY OF INOCULATION—ITS PHENOMENA, AND EFFECTS IN ABATING THE RAVAGES OF SMALL-POX—REPLACED BY VACCINATION, OR THE ARTIFICIAL PRODUCTION OF COW-POCK.

Casual Small-pox. It has been disputed by writers of the highest authority in medicine, whether Small-pox was known to the ancients; the affirmative of the question having been maintained, by Rhazes, Salmasius, Willan, Baron, and others; whilst, on the opposite side, are found the names of Friend, Mead, and Good,—no mean authorities on such a subject. But there is too little of practical utility in the question,

to induce us to take part in its discussion. Rhazes, who wrote in the ninth century, appears to have been the first to treat distinctly of the disease, although the occurrence of both Small-pox and measles as early as the year 572 (the era of the birth of Mohammed), is expressly mentioned in an Arabic manuscript,[1] preserved in the University of Leyden; but, whether that document be certainly genuine, or not, at all events, from the allusions made by Rhazes to the opinions of Ahron, and others of his predecessors, we cannot err in dating the appearance of Small-pox anterior to the period of the Hegira, as it frequently broke out, during the seventh century, in the wild, fanatic legions led forth by the great prophet of Mecca, to propagate the doctrines of the Koran by the edge of the sword. Thenceforward, at all events, Small-pox has proved one of the most destructive of human maladies, whether appearing in its sporadic form, or in those terrible epidemic irruptions, in which it has smitten its victims as fatally, as numerously, and scarce less suddenly, than the destroying angel who passed of old over the doomed hosts of the Assyrian camp.

A few illustrations of what we have asserted will suffice. When introduced into Mexico, not long after the discoveries of Columbus, this fearful pestilence cut off, within a brief period, not less than three millions of the unfortunate natives; and it is well known, that whole tribes of the Red men of Western America, who, from this and other causes, are fast disappearing from the footfalls of their fathers, have been swept away by the same malady. In England, 40,000 individuals are said to have perished annually; and two millions, on one occasion, in Russia in a single year. Haygarth attributed to this cause one half of all the deaths taking place in children under ten years of age; and, of all persons attacked by Small-pox, one-fourth, or at least one-fifth, are believed to perish; whilst, according to the experience of Dr. George Gregory, the mortality is even greater than this. At the Small-pox Hospital, for the last half century, the fatal cases have ranged from eighteen to forty-one in the hundred; averaging, on the whole, about thirty per cent.[2] Nor is this all, for one attack of the malady, even in its severest form, does not invariably protect the survivor from a second, as is clearly shown by ample experience. The extent of this consecutive liability, however, has been variously estimated by different authorities: thus, the proportion of secondary attacks of Small-pox, to the primary, is computed, by La Condamine as 1 in 50,000; Heberden, as 1 in 10,000; other authorities, as 1 in 8,000; Eichorn, as 1 in 250; and Mohl, in

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[1] Hamilton's History of Medicine, vol. i.

[2] Cyclopædia of Practical Medicine. Art. "Small-pox", p. 742.

his description of the Copenhagen epidemic, asserts that every sixth person who suffered from the disease, had it for the second time.

The calculations just quoted are evidently too widely discrepant to do more than establish, generally, the fact, that the disease may occur a second time; and, on some occasions, as in the Danish physician's experience, in a high proportion; but they shew conclusively, at the same time, that we have no data for determining any law as to the frequency of the occurrence. The general proposition, however, of the liability to a second attack, was known as early as the times of Rhazes and Avicenna; and probably there are few practitioners who are not, from their own experience, cognizant of it; but, at all events, Baron, in his life of Jenner, alludes to no less than one hundred and thirty different writers, who have given examples of this occurrence. Were it necessary to strengthen the evidence on this point, we might refer to the reports of Heim and the Wirtemberg physicians, showing, that of 297 persons who bore evident marks of the Small-pox, Vaccination failed in only 126 cases, succeeding perfectly in 95, and affecting the remaining 76 in a modified form. Indeed, the entire statistics of the authorities referred to, show that more than a half of all the individuals operated on, after Small-pox so severe as to leave their persons marked by scars, had again become liable to the disease. In coming to this conclusion, they assume, perhaps correctly, that susceptibility of the contagion of Cow-pock indicates an equal liability to that of Small-pox: this, however, is a debateable question, to which we shall return hereafter. But not only is the possibility of the recurrence of Small-pox, in the same individual perfectly established, but equally so the fact, that the secondary attack may be extremely severe, and even fatal. A well-known instance of this unfortunate result occurred in the person of Louis XV of France; and at least one fatal case has happened within our own observation. The experience of Macintosh supplied twelve instances of secondary attacks; and he adds, "all my cases of secondary Small-pox, with the exception of two, have been remarkably severe, whereas, I have not seen a severe case after Vaccination." And when to the fearful mortality just described, are added not only the virulently contagious nature of the disease, but the long catalogue of melancholy results which follow in its train, including tubercular consumption, various forms of scrofula, hideous disfiguration of the countenance, and blindness, it may readily be believed that any feasible plan of mitigating its horrors was calculated to excite intense interest; and this plan was found in the practice of variolous inoculation.

Variolous Inoculation. The artificial production of Small-pox by Inoculation, is a practice alleged to have existed amongst the Chineses

and the inhabitants of Hindostan from remote ages, and to have been also long known to the people of various countries of Europe; but its power of ameliorating the virulence of the casual disease was first formally announced, in a communication made to the Royal Society of Edinburgh, early in the eighteenth century. About the same period, the observations of Pylarini, Venetian consul at Smyrna, and a notice of the letter of Dr. Timoni, on Inoculation, written from Constantinople, were published in the *Philosophical Transactions*. Further attention was drawn to the subject by the writings of Mr. Kennedy, but without any practical effect, until the pen and personal influence of Lady Mary Wortley Montague seriously attracted the notice of the public. The practice of Inoculation, thereafter, gradually made its way in England, although violently opposed by many eminent members of the medical profession, and denounced from the pulpit as the offspring of atheism, and a diabolical invention of Satan. Subsequently, however, to the year 1730, it fell into almost total disuse in these kingdoms; and was actually prohibited by law in France. In 1754, a declaration was made by the London College of Physicians in favour of the practice, but without any decided effect, until its successful results, in the hands of the Brothers Sutton, rendered it generally popular for some time. In 1746, the Small-pox and Inoculation Hospital of London was founded, for the purpose of extending the benefits of the discovery to the poor; and the results, in that establishment, were favourable. In the following year, Inoculation was powerfully supported by the influential pen of Mead;[1] and Baron Dimsdale[2] followed the Suttons with much success. His plan of operating, which has not been improved on, was generally adopted for the next twenty years, and with increasing popularity, until Jenner, in 1798, announced to the world his great discovery of Vaccination. Since that period, the general practice of Variolous Inoculation has fallen into disuse.

With reference to the individual, the advantage of Inoculation, however, was fully established. It abridged, by several days, the incubative stage of the disease: it lessened the quantity of the eruption; and so greatly abated the malignancy of the symptoms, that the deaths in the Inoculation Hospital only amounted to three in one thousand cases, whilst the mortality from the casual disease at that time, and even now, according to Gregory, amounted to *three* in every ten persons attacked by the malady. The following phenomena, usually occurring after Variolous Inoculation, may be contrasted with the unameliorated horrors of the casual disease.

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[1] De Variolis et Morbillis. [2] Present Method of Inoculating for Small-pox.

Inoculated Small-Pox. About the third or fourth day, a slight redness, and a trifling degree of induration, perceptible to the finger, may be observed at the point of operation. On the fifth day the redness is more vivid; and on the sixth, the cuticle is generally elevated by the effusion of serum, a central depression being observable at the same time. On the seventh day, irritation of the superficial lymphatic vessels occurs, the arm in the vicinity of the puncture becomes painful, and the general symptoms of fever are developed. The eruption, whether local or general, commences to decline from the twelfth to the fifteenth day, after the date of the operation; the pustule being replaced by a scab, which falls off in a week or ten days more, leaving behind it an indelible cicatrix.

The question then arises, why a practice, so manifestly beneficial came to be almost completely abandoned, at all events, by the medical profession? Several circumstances contributed to this result. It was found, on examination, that the malady produced by Inoculation, although mild in the majority of cases, was not invariably so; for many persons, after the operation, passed through a very severe form of Small-pox; and no inconsiderable number died of the disease thus artificially produced. Like casual Small-pox also, the engrafted malady was found to excite in the system various consecutive disorders, and, especially, to arouse into activity any lurking scrofulous taint. These were serious risks for the practitioner to incur by his own act; and as it was impossible to foresee, in any given case, what might happen, the objection to the production of a disease artificially, which in the common course of events might, probably, never occur at all, became very strong; for, even at the worst, it appeared that a vast majority of the people, without any precautions whatever, escaped altogether an attack of casual Small-pox. Another objection, and, as regards the public, a very weighty one, was the unquestionable tendency of Inoculation, without careful seclusion and proper precautions, to promote the diffusion of contagion. It may be true, as Adams,[1] Watkinson, and Schwenke, have attempted to shew, that the danger has been overrated; but the sources of infection were so much multiplied by the practice, as Dr. Gregory justly remarks, that the casual Small-pox, which formerly visited country places at long and uncertain intervals, was now to be met with in all parts, at all times; 45,000 persons being annually cut off by its virulence.[2]

Experience also taught, that Inoculation, however confidently asserted

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[1] Inquiry into the Laws, etc., of Epidemic Diseases.

[2] Cyclopædia of Practical Medicine. Article, "Small-pox."

to prevent a second attack of the malady, had, by no means, invariably this effect; on the contrary, many writers affirm that secondary attacks were more frequent after the artificial, than the casual disease. This last statement has been controverted by the high authority of Dimsdale; but, at all events, as has been more recently shewn by Baron, death occurred in the proportion of one in every fifty of the inoculated.

Inoculation was prohibited, by Royal authority, in France in 1763; but the death-blow to the practice was not given, as already intimated, until the promulgation of Jenner's discovery, about a quarter of a century later.

II. Vaccination, History of—Symptoms and Objects—Arguments in favour of its protective influence—Objections—how far, and in what manner, it has been shewn to fail.

History. After a lengthened investigation of the subject, Jenner first announced, in 1798, in his well-known *Enquiry into the Causes and Effects of the Variolæ Vaccinæ*, that the Cow-pock, having passed through the human system, after being transferred from the teats or udder of the cow, by the process of Inoculation, ever after guards individuals, so operated on, from the contagion of casual Small-pox; and that, by the universal adoption of Vaccination, this dreadful disease might not only be divested of all its terrors, but be finally extinguished from the list of human maladies. Residing at Berkeley, in Gloucestershire, in one of the great dairy districts of England, his attention was first turned to the subject by a knowledge of the popular belief, which he found prevalent, that Cow-pock, when casually transferred to the hands of the milkers, subsequently protected all persons so affected, from an attack of Small-pox. And to the establishment of this doctrine, by accumulated observations and arguments, as tending to confer incalculable benefits on the human race, he devoted a great part of the remainder of his long, honourable, and useful life. Jenner did not, however, escape the common fate of great discoverers; for although the majority of the medical profession eagerly and gratefully adopted his views, yet, by a few, the value of his announcement was depreciated, his motives questioned, and even his character maligned. Time, however, has done justice alike to him and his traducers; and even if it could be shewn, unequivocally, that his views were partially erroneous, enough would still remain to entitle him to the undying gratitude of the human race, whilst his ardent desire for the good of his kind, and his patient and Christian bearing under the detraction of his enemies, as well as the untiring industry, the deep sagacity, and profound reasoning, which he

displayed in the defence of what he conceived to be true, will for all time to come confer celebrity on his name. "Τό ὄνομα ὄυπστ' ὀλώλει."

In 1799, Vaccination was introduced into America by Dr. Waterhouse; and, in the same year, a testimonial of confidence in the discovery of Jenner was signed by a large number of the most eminent physicians and surgeons of London, including the distinguished names of Cline, Cooper, Baillie, and Abernethy.

In 1800, the practice was adopted in France. Amongst the warmest of its advocates on the Continent, we may enumerate Sacco of Milan, and De Carro of Vienna, by the exertions of the latter of whom, Vaccination reached Bombay, and was thence diffused all over India. As early as 1801, six thousand persons had been successfully vaccinated in Great Britain alone. In the year 1802, a remuneration of £10,000 was voted to Jenner by the British parliament, and a further sum of £20,000 in 1807, sixteen years before his death, which took place in 1823, when he had reached the advanced age of seventy-four years.

In 1833, a Committee of the House of Commons made a report on the Vaccine Board, and on the practice of Vaccination generally, which contained the latest information on the subject, up to the period in which it was drawn up. More recently, the question has been ably discussed in Dr. Baron's *Life of Jenner*, and in the Report of the Committee, appointed by the Provincial Medical Association, to investigate the subject in 1839. Within the last few years, a short Act of Parliament was passed, commonly called the Vaccination Act, with the praiseworthy object of promoting the more general diffusion of Cow-pock, by providing remuneration, to be made out of the poor-rates, for each successful operation. In Norway and some of the other continental kingdoms, Vaccine Inoculation is enjoined by law, and the practice is more or less prevalent throughout every country in the world.

Effects. The doctrines of Jenner have been maintained, since his death up to the present hour, by many distinguished writers, not the least celebrated of whom is Dr. Baron, his able biographer, who was principally concerned in drawing up the Report already alluded to, as emanating from the Provincial Medical Association. The views there advocated will briefly appear, from the following abstract of the petition, founded on the report, and directed to be presented to Parliament: "Your petitioners have learned by the concurrent testimony of a very large proportion of their members, that Cow-Small-Pox, if duly and carefully communicated, has an enduring influence in protecting the constitution; they admit that this protection is not in all cases complete, but they have unquestionable proof of its being capable, if generally and properly employed,

of mitigating, controlling, and they might almost say of extinguishing, Small-Pox in any district."[1]

Many observers, however, both on the Continent and these countries, —and the number has been increasing for some years,—only partially subscribe to the doctrine of Jenner, contending that Vaccination, although it may impart the protective influence to an unascertained proportion of those submitted to the operation, by no means does so to all; and that even where imparted, it is liable to wear out, and leave the system again susceptible of the contagion of casual Small-Pox. A few maintain that the Cow-pock, in its most perfect form, confers neither permanent nor temporary protection. In addition to the grand object of destroying the liability to Small-Pox, or at least mitigating its severity by Vaccination, the practice has been advocated, by ascribing to it several subsidiary advantages, the chief of which is the comparative safety of the operation as compared with Variolous Inoculation, both to the individual and the community, from the tendency of the latter to multiply the sources of contagion, and consequently to extend the ravages of the disease.

Minor benefits derivable from the artificial production of Cow-pock, are alleged to be, an occasional tendency to ameliorate the process of dentition, and occasionally to effect a cure of various cutaneous diseases. These collateral benefits of Vaccination we shall dispose of first, and thus leave the space clear, for the discussion of the grand question of protective influence.

It is asserted by Heim that the process of dentition is, in many cases, accelerated by the development of the Cow-pock, and Capuron admits, that it is, at least, not rendered more troublesome. Jenner, and several other writers, bear testimony to various chronic affections of the skin having been rendered milder, and even actually removed by Vaccination. Amongst the diseases specified, are scabies, herpes, porrigo, and impetigo; and Valentin adds ophthalmia, and scrofula; nor does there seem to be any valid objection against trying the effects of Vaccination in such cases, provided we do not allow the lymph, resulting from the operation, to be made use of, for the transmission of the Cow-pock to others. We do not, however, advise our readers to hope for any very striking success from this practice, as it will be found, in the majority of instances, as unsuccessful in arresting the progress of any severe cutaneous diseases, as it turned out, in the hands of Dr. M'Cormac, when experimenting on its effects, in a case of hooping-cough.[2]

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[1] See the Report; also, British and Foreign Medical Review, No. xvi, p. 613.

[2] Methodus Medendi.

Other advantages possessed by Vaccination are the absence of that tendency to produce, in any case, a number of confluent pustules with their consequent deformity, and to rouse into activity, the germs of scrofula and other constitutional diseases, which is well known to mark the course of Small-pox, whether arising casually, or dependent on inoculation. We are aware that it is alleged, that even Vaccination may produce a deterioration of the blood, and give rise, also, to a variety of cutaneous affections. This alleged deterioration of the blood, however, is a mere hypothesis, and, as such, deserving of no further remark. That boils, pustules, certain cutaneous eruptions, and smart inflammation, may now and then follow the Cow-pock, although rarely, where the health of the patient is in a satisfactory state, we are assured from personal experience; but even here a comparison of the operation, with that for variolous inoculation, is in favour of the former, for such diseases are much more frequently observed after Small-pox, and, as pertinently observed by the late lamented Professor Burns, whose memory is deservedly held in the highest respect, no new cutaneous affection has followed the introduction of Vaccination. But, even at worst, when compared with the great advantages of Vaccination, this objection would scarcely be worthy of notice, except with the view of correcting a vulgar error, viz., that the cutaneous affections alluded to, depend on impurity of the virus employed. Manifestly, in the majority of cases, this is not so—but the result is dependent on the state of the constitution at the time of the operation; for the same lymph will produce the effects in question in one child, and not in another, as I have, over and over again, had the opportunity of observing.

The tendency of Vaccination to diminish the prevalence of Small-pox, by rendering less numerous the sources of infection, is so self-evident, that we need not dilate on it here, although, as regards the community, it is a matter of very great importance.

And, even in point of safety, the operation for Cow-pock has an immense advantage over variolous inoculation, for, to say nothing of the comparative mildness of the symptoms of the former, it is not to be overlooked, that a considerable mortality arose from the artificial Small-pox, even after the most careful preliminary preparation for the operation. The average number of deaths from this cause, at the Inoculation Hospital, is stated to have been three in one thousand cases, and the mortality consequent on Vaccination is certainly very much less than this, although little or no medical treatment, either preparatory, or during the progress of the disease, is either practised, or, indeed, considered necessary. Many practitioners, of considerable experience in this branch of practice,

have never seen a single case of Cow-pock terminate fatally in the human subject; still, the possibility of such an occurrence has been sufficiently determined. In Germany, according to Heim, of 208,322 children submitted to the operation, 70 died; and at Baden, 79 deaths occurred out of 98,198 cases. The proportion of one fatal case in rather more than 2,000 individuals is not large, even if it could be unequivocally shown, that all the recorded deaths were necessarily dependent on this cause, and the results might therefore be advantageously contrasted with the mortality arising from variolous inoculation. But in these kingdoms, we are able to infer with certainty, after extended inquiry, that the fatality is infinitely less; and in my own personal experience, extending to a thousand cases in one year, I have never seen the operation terminating in death, even in a single case, and Dr. Baron has only seen one. Nothing further need therefore be advanced as to the superiority of Vaccination in point of safety.

Protective Influence of Vaccination. The great practical question —*Whether, and how far, does Vaccination protect from a Subsequent Attack of Casual Small-pox?* now remains for discussion. And first, with reference to the groundless assumption, that Vaccination affords no protection whatever, we believe it to be so directly contravened by the most conclusive testimony, and by well-established facts, that no other reply seems necessary, but to adopt the language of Capuron— "Experience and observation constitute an answer to their foolish and absurd declamations." The evidence in favour of the protective and modifying influence of Vaccination may be arranged as follows.

a. Popular experience, as to the immunity enjoyed by those who have casually contracted Cow-pock from the cow, horse, or camel.

The discovery of Jenner, as before stated, arose out of the popular belief, prevalent in the dairy counties of England, that the casual transfer of a peculiar form of disease from the udder of the cow to the hands of the persons engaged in milking, defended such persons, ever after, from the liability to Small-pox; and it was only after a long and patient investigation of this point, that that eminently sagacious physician came to the conclusion, that the popular belief was founded in truth. His researches have, therefore, tended to lighten, greatly, the labours of subsequent investigators, by clearly pointing out the precise characters of the pock, which alone can impart the desired impunity, and which it is therefore necessary carefully to discriminate from a variety of diseases having a general resemblance to the genuine malady, but conferring no exemption from a subsequent attack of Small-pox. Jenner, however, erred in supposing the casual variolæ vaccinæ to be, invariably, a purely local disease, whereas it is frequently a constitutional febrile

affection, generally mild, and accompanied by an eruption; but occasionally severe, and even fatal. Thus, at Moorshedabad, the pustules appeared all over the body, about the fifth or sixth day after the animal became indisposed, with fever and much distress, and went on to ulceration, the hair falling off wherever a pustule had run its course. The mouth and fauces, being one mass of ulceration, impeding mastication, were the principal seats of the disease, which proved fatal, apparently from inanition, in the proportion of from fifteen to twenty per cent.

According to Ceely,—to whose minute and correct history of the symptoms, collated, however, with various other accounts, we are principally indebted for the following description,—the casual Cow-pock appears most generally in the spring, and in a sporadic form. The disease is, however, occasionally epizootic; but Mr. Ceely has not been able to trace it to the equine vesicle, and he adds, that in England, fever is rarely observed. The first perceptible symptoms are heat, tenderness and induration of the udder, followed, about the fifth day after exposure, by small papulæ, affecting also the teats. In cows with white skins, circumscribed indurations appear about the sixth and seventh days, of a reddish colour, as large as a pea, and circular, ovoid, or lozenge-shaped, with a central depression, in which is visible a small dirty yellowish-white discoloration, surrounding a still darker dot or line. The indurations are often interspersed with minute red papulæ, of a darker colour, rather acuminated, and frequently abraded at the summits. Some of the tumours have a slender amber-coloured, yellowish-brown, or black central crust, and are less prominent than those without the crusts. On the eighth and ninth days, the central depression, frequently of a blueish tint, becomes more apparent, as well as the elevation of the margin, which is solid, uniform, tense, and shining, of a glistening pearly, or silvery hue. An areola of a pale rose, or light damask-colour, a line or two in width, is frequently apparent round the base. In others, the central crust has increased, and is yellow, brown, or black; some appear a little pustular in their centres. A few small conoidal vesicles, some of them with a slight depression on the apex, appear to have subsequently arisen on the teats, but in general, the majority of the tumours on these parts are more or less abraded, and lymph is seen exuding from their centres, the cuticle being loose, or partly detached, whilst brown and black incrustations, and other alterations from the natural characteristic appearance, are manifest. About the tenth and eleventh days, the disease usually reaches its acme, when the tumours are often eight or ten lines in diameter, the centres and central edges of the intumescent margin are of a deep blue or slate-

colour, and the areola, under which the integuments are deeply indurated, generally of a pale rose-colour, is seldom more than four or five lines in extent. The lymph, now abundant, raises the cuticle, and forms a globular or conoidal vesicle, or freely flows out from its rupture. From this period the induration subsides, and the incrustation and desiccation proceed, until the crusts spontaneously separate, from the twentieth to the twenty-third days, leaving shallow, smooth, oval, or circular cicatrices, of a pale rose, white, or yellow colour. When the process is disturbed, we may observe on the teats, large black, solid crusts, often more than an inch or two in length, or they appear abraded, ulcerated, and bleeding.[1]

It has been affirmed by Reckleben and Thär in Germany, as well as by some observers in this country, that milch-cows are alone subject to Cow-pock, but Heim has shewn that this is not consonant with fact. The truth is, that milch-cows, from causes that must be obvious, are certainly more liable to the disease than young cattle, which are less exposed to inoculation by the hands of the milker; but the latter are by no means entirely exempt.

The lymph from the genuine vaccine vesicle just described, when accidentally transferred to any abraded surface on the milker's hand, and absorbed, reproduces the disease usually termed casual Cow-pock in man, which is marked by an eruption of inflamed spots, the tendency of which is to terminate in suppuration. The pustules are bluish, and circular, with elevated edges; and the consecutive phenomena include swellings in the axilla, fever, headache, vomiting, and, occasionally, delirium. These symptoms decline in three or four days; but the sores are painful, and very frequently heal with difficulty.

Bastard forms of Cow-pock, on the hands of the milkers, arising from spurious varieties of the disease in the cow, are of frequent occurrence, and, from their incapability of imparting any protection to the system, have proved a frequent source of error. The most usual appearances of the spurious disease are described in another part of this paper; by contrasting which, with the above minute description of the genuine malady, they may be readily distinguished from each other.

But, rigidly speaking, this popular belief in the general immunity, conferred by casual Cow-pock, cannot be admitted as a conclusive argument, until it shall have been determined, by a sufficient body of statistical information, to be certainly true. This, hitherto, in our opinion, is by no means the case; but, at the same time, the proposition has been rendered so probable, by the investigations of Jenner, and others

[1] British and Foreign Medical and Surgical Review, No. xx, p. 465.

since his time, as to entitle it justly to the place of a strong corroborative argument, in favour of the efficacy of Vaccination. It is not, however, to be looked for, as a result of further examination of the subject, that the protection, which Cow-pock is capable of conferring, shall be invariably present in all cases. This was an error into which Jenner fell; for the immunity, arising even from casual and inoculated Small-pox, is liable to numerous exceptions; and no other result can reasonably be expected in the case of Cow-pock.

Having thus pourtrayed the casual disease, as it displays itself, both in the cow, and in man, we shall now minutely describe the symptoms, which follow the transference of genuine lymph to the human subject. This is a part of the subject of great importance; because all our reasoning, as to the protective influence, has reference to the genuine character of the disease; and the truest test of this is the complete and regular process of the vesicle, with its attendant symptoms, throughout its entire course.

Symptoms of inoculated Cow-pock. After the insertion of the genuine virus, the puncture ceases to be apparent for a few days, which may be termed the period of abeyance; but it has been observed by Gregory to assume a vesicular form, under the microscope, within eight-and-forty hours. On the third, or fourth day, an inflamed speck becomes visible to the naked eye, which gradually increases in size, and forms a small, slightly prominent tumour, presenting in its centre a dark point, formed by the commencing secretion of the lymph. This point gradually increases in size, and becomes a small transparent vesicle, either of a dull white colour, something like a pearl, or, occasionally, yellowish, with a circular, or sometimes an oval base, especially if the operation has been performed with a longitudinal scratch. The margin is well defined, being rounded, turgid, red, and shining; the centre is umbilicated, or dips instead of being polarized; and this form remains until the eighth, or ninth day, when the vesicle sometimes becomes more elevated in the centre than at the circumference. Frequently there is scarcely any perceptible fever; but more usually, about the eighth day, a degree of constitutional disturbance takes place, which is indicated by slight headache, and lassitude, and possibly by shivering, loss of appetite, heat of skin, increase of pulse, disordered bowels, pain of the arm-pit, and occasional enlargement of the axillary glands. These febrile symptoms may be present for a day, or two, but they almost invariably then subside, leaving no trace behind. About the eighth day, a little sooner or later, the vesicle is surrounded with a circular, inflamed halo, or erythematous areola, marked by intense itching, redness, and slight swelling of the surrounding membrane, and varying,

in diameter, from one to two inches, in different cases. The areola is, occasionally, the site of a number of small vesicles. This local inflammation is the pathognomonic proof of the system being affected with the disease. About the ninth, or tenth day, the vesicle acquires its greatest magnitude, and is equal in diameter to the third or fourth part of an inch, and about the size of a split pea. About the eleventh day, all the symptoms decline; the hue of the areola becomes gradually fainter, and, in a day or two, as it begins to fade imperceptibly away, it leaves two or three concentric rings, of a bluish light grey. It is scarcely distinguishable on the thirteenth day after the operation; at which time the vesicle hardens into a dark brown, circular scab; the fluid for two or three days previously having begun to dry up, first at the centre, and to assume something of a purulent consistence. This, if not rubbed off, or interfered with, falls off towards the twentieth to the twenty-fourth day, leaving the skin perfectly whole, but marked by a permanent cicatrix, about the third, or half of an inch in diameter, which is marked by a number of pits, corresponding to the cells of which the vesicle had been composed. Each puncture produces but a single, multilocular vesicle, the little cells of which communicate with each other, and secrete a perfectly transparent, colourless lymph, not however, as stated by Good, during the entire progress of the disease. For, although Cow-pock is considered rather a vesicular, than a pustular malady, the vesicle becomes turbid towards the close, and actually secretes genuine pus. Such is the usual progress of the genuine Cow-pock. It may, however, present various deviations from the regular course, which may be looked on as immaterial, and which are, therefore, to be carefully distinguished from such aberrations as would interfere with the due impregnation of the system. In the former class we may enumerate the following peculiarities: more or less violent inflammation, sometimes even extending to the trunk of the body, is occasionally observed, terminating in a profusely discharging ulcer, instead of the characteristic scab; but this, though requiring local applications, and at times even general remedies, of a cooling nature, does not, in the opinion of Gregory, militate against the protecting influence of the vaccine operation, and my own experience is to the same effect. The same physician describes a papular eruption, appearing about the tenth day, occasionally spreading from the extremities to the trunk, and most usually occurring where numerous vesicles have been raised on the arm, indicating, as he alleges, a full effect upon the system. The lichen, here described, is by no means unfrequent, but it may follow spurious, as well as genuine Vaccination, and cannot therefore be looked on, as any certain test of the efficacy of the operation.

The occurrence of vesicles, except on the points punctured, is very rare; but if present, they may be considered as a proof of the energetic operation of the virus on the system. In certain cases, these supernumerary vesicles have been attributed, by Cazenaave and Schedel, to transference of the matter by the nails, after scratching; but this appears to be a very questionable cause, and, at any rate, the effects may occur quite independently of it.

The phenomena of Vaccination in the adult are the same as in the child, with a few unimportant variations, which have been correctly described by Gregory. Thus the vesicles are thinner, and consequently, more easily ruptured, the lymph generally presents a yellowish tinge, and the areola is more extensive, the axillary glands more frequently become swollen, and the consecutive fever is greater, with less tendency to secondary lichen, than in children. But such slight anomalies neither interfere with the protective power, nor the contagious properties of the lymph, although, for reasons which will appear hereafter, we should avoid selecting it for transmission of the disease.

b. The Identity of Cow-pock and Small-pox an argument in favour of the protective influence of Vaccination.

It was maintained by Jenner, on theoretical grounds, that the diseases in question were identical, the Small-pox being merely a malignant variety of the Cow-pock; but it is of importance to show, that the correctness of his opinion, in part at least, has been established by evidence, both sufficient in point of amount, and satisfactorily attested, to gain the assent of all those who are not unreasonably and pertinaciously sceptical. In asserting the identity of the variolæ vaccinæ and Small-pox, Jenner has found supporters in Wedekind, Henry,[1] Baron, and many others. But no actual experiment in favour of their opinion, however rational, was adducible, until Dr. Sonderland, of Bremen, communicated the disease to a cow, by enveloping her in a woollen bed-cover removed from a patient, who had died of Small-pox;[2] and fine vaccine lymph was procured in Egypt in the same way. As the experiment, however, was not followed by like results in the hands of Gregory, Numann, and Macpherson, the statement of Dr. Sonderland became unjustly discredited, until Gassner, Fomin, and Dr. Basil Thiele, of Kasan, succeeded in producing the genuine vaccine disease in the cow, by inoculation with Small-pox matter. Finally, the question must be looked on as settled by the unexceptionable experiments

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[1] On the Laws of Contagion. [2] Petition of Provincial Medical Association.
[3] See Mr. Ceely's Experiments; British and Foreign Med. Rev., No. xvi, p. 614, et seq., and vol. xiii, p. 781; also, Med.-Chir. Rev., Jan. 1834.

of Mr. Ceely, of Aylesbury;[3] for, the virus of human Small-pox having been communicated by inoculation to the cow, a pock was the result, resembling in all essential particulars the Cow-pock, and which, like the original vaccine disease, afforded a lymph with which some hundreds of persons have been successfully vaccinated, and the efficiency of which has been subsequently tested, both by inoculation of the persons vaccinated, and by their exposure to the contagion of the casual disease. Nor is there anything very remarkable in the artificial communication of Small-pox to the cow; for M. Viborg had previously succeed in producing the disease in dogs, apes, and swine, in the same manner.[1] In the dog, the vesicle, although evidently smaller, runs the same course as in man. In Lombardy, and in Persia, it has been observed in the sheep as well as the cow, and also in South America by Humboldt and others.[2] The camel too, is susceptible of the disease, as we learn from the communication of Dr. Winchester, in the *Indian Journal of Medicine*, quoted in the nineteenth number of the *British and Foreign Medical and Surgical Review*.

It appears that, in the province of Lus, the camel milkers are subject to a malady termed "*Photo-Shootur*," the Small-pox of the camel, that complaint being designated by the term *Photo*, in the district in question. This is a pustular disease, affecting the hands and arms of the milkers, which is derived from a similar affection on the udder of the camel, closely resembling that on the udder of the cow. No one is ever known to die from this disease; and it is remarked by the natives that those who have been subject to this camel-pock are invariably free from Small-pox, which occasionally prevails as an endemic in that district. It is generally known, that Jenner attributed the sole origin of the disease in the cow, to a complaint affecting the heels of horses, which he erroneously supposed to be the grease, but which has subsequently been ascertained to be a peculiar vesicular disorder affecting not only the heels, but the limbs and body of that animal, and capable of communicating the Cow-pock either to the cow, or directly to man, as fully shown by Loy, Sacco, and De Carro. Of this equine form of the disease, or *pferdemauke*, Professor Hering adduces two instances exhibiting all the characters of perfect identity with the vaccine malady. But this is not the only source of the complaint affecting the cow, for it is well ascertained, as stated by Griva, that it has been observed to occur in that animal spontaneously in Switzerland, the north of Italy, Rome, Germany, Wirtemberg, Holland, France, and Ireland. Dr.

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[1] Med. and Phys. Journ., Sep. 1802.

[2] Baron's Life of Jenner, vol. i, p. 239.

M'Cormac suggests, that the disorder in the horse may have been derived from the cow, but it would be extremely difficult, if not impossible, to determine whether the disease originated in man, or in the horse, or the cow; and, at any rate, it is sufficient to know the fact, that it may now occur independently in each, and that it is mutually communicable from the one to the other. In giving an impartial view of the subject, however, we should not omit to state the arguments, which have been advanced against the identity of the diseases, which we have been considering, although such objections must now go for nothing, since the establishment of the point at issue by authentic experiments. The first of the objections in question to which we shall allude, is the comparative mildness of the vaccine disease; but the force of this argument, if it have any force, is obviated by knowing that the variolæ vaccinæ have prevailed, as in the year 1825, in as severe and fatal a form, as the Small-pox in man. It must be admitted, however,—indeed it is on this that the value of Jenner's discovery entirely depends,—that, in general, the character of the malady has been rendered infinitely milder, by its transmission through the cow. Another point of difference well established between the two forms of the disease is, the atmospheric transmissibility of the contagion arising either from the casual or inoculated Small-pox, whereas it is not known that the Cow-pock can be conveyed, except by direct contact. It has also been asserted, that the vesicles arising from the vaccine lymph are invariably confined to the points of puncture; and, as a general rule, this must be admitted to be true. But, from whatever cause arising, it is not invariably the case. Thus it sometimes occurs, that Vaccination is performed on individuals exposed to the variolous contagion, and, in such cases, an eruption, more or less abundant, may appear on various parts of the body. Cazenave and Schedel explain this, by saying that the eruption is only Small-pox modified by the process of Vaccination. But it has been further alleged by some physicians, that they have employed the lymph taken from this supposed Cow-pock eruption, and produced therewith genuine vaccine vesicles; in commenting on which, the authors in question observe, that in such cases, the operators have either grossly deceived themselves, or that the malady thus developed has truly the appearance of Cow-pock. Admitting this, they inquire, what becomes of the distinction between Cow-pock and Small-pox?[1]

By the German physicians, a secondary eruption has been observed to accompany the vaccine process, presenting variously the appearance of a spotted rash, or a papuliform, vesicular, or even pustular disease;

[1] Maladies de la Peau, p. 79.

occurring usually between the eighth and fourteenth days, and remaining for two or three days, or even for a week. In some cases, the eruption assumes the appearance of chicken-pox; and in others, partially, or even entirely, resembles the genuine Cow-pock, and appears on various parts of the body.

Still, such appearances as these last are extremely rare, as I have not observed more than two, out of some thousand cases, in which the pock was not limited to the point of insertion. At one time, Dr. Geo. Gregory was directly opposed to the doctrine of the two varieties of pock being identical, inasmuch as no direct experiments had proved that Cow-pock can be communicated from man back to the cow;[1] but his statement is not in accordance with the experiments of M. Fiard.[2] At the same time, on the grounds that diseases which mutually produce each other, are clearly referable to the same source, he admitted the identity of Small pox and swine-pox; but, in the same train of argument, he denied that Cow-pock and Small-pox were identical, as the former never produced the latter in the human system; and Small-pox, however mild, never approaches to the character of Cowpock. The inconsequential character of this mode of reasoning is apparent, but need not be insisted on, as late observations have fully established the identity of the two diseases; and it is difficult to see how any other inference could be arrived at, after the conclusive experiments of Ceely, unless we are prepared to assert that one malady is capable of producing, by inoculation, another of a totally different nature.

This identity unquestionably supplies a powerful argument in favour of the efficacy of Vaccination; for those who believed that Small-pox and Cow-pock were essentially distinct diseases, might very justly object to the belief in the impunity alleged to be conferred by the latter, that there was no known instance of any one malady having the effect of destroying the liability to another. But the fact, as now established, both obviates the objection, and explains what was previously very mysterious; so much so, that a conviction of the non-identity of the two diseases would go far to shake, *in toto*, our belief in the real efficacy of Vaccination. Cow-pock, therefore, being determined to be essentially the same disease as Small-pox, which is confessedly one of that class of maladies in which a first attack destroys the liability to a second, the inference appears unavoidable, that Cow-pock should confer a like immunity; but the extent of that immunity can only be deter-

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[1] Medical Gazette, vol. i, p. 781-2.

[2] La Lancette Franç., 1835. Report of M. Gérardin on Vaccine, 1833. British and Foreign Medical and Surgical Review, No. iii.

mined by the result of experience. Reasoning from analogy, and the observed effects in other diseases, we should be led to the conclusion, that the amount of the protection imparted by an attack of Small-pox, whether in its severe and casual, or in the mild and modified form of Cow-pock, would be the same ; for we find that the constitution is equally protected from a second attack of scarlatina or measles, whether the primary disease may have been of the most malignant, or the mildest nature. But, as already stated, this is a question which can only be satisfactorily determined by extensive and accurate observation.

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 cerevisiæ*."

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.

NATURAL SMALL-POX.	INOCULATED SMALL-POX.	VACCINE SMALL-POX.
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 acuminated, about the eighth day, and contain sero-purulent matter, attaining the maximum size of a pea about the eleventh day, when secondary fever occurs.	By the tenth day, the primary pustule is full of matter. No secondary fever.	Areola on the eighth or ninth day. Fever slight, sometimes inappreciable, about the eighth or ninth day. No secondary fever.
The pustules break and scab about the twelfth day, and the crusts fall off in a few days more.	The primary pustule scabs about the fourteenth day; and by the end of the third week the disease disappears.	Scabbing takes place about the twelfth or thirteenth day, and the crust falls off about the end of the third week.
Pustules leave, when severe, permanent scars.	Primary pustule, and the secondary pustules, when severe, leave permanent cicatrices.	Vesicle usually leaves a permanent striated cicatrix.

d. Testimony in favour of the protective influence of Vaccination. This is almost universal, 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 Cow-pock. 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, is 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. It was 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 to be 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 29 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 Gregory[2] 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, in any given case, may be of the mildest form, it may convey, by infection, the most malignant type of the disorder to others.

Another mode of testing the efficacy of Vaccination is by a secondary operation, or 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 merely 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 acuminated, and dies away about the eighth day. Or the vesicle may resemble the genuine one, in other

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[1] Medicinische Zeitung, in Brit. and For. Med. Rev., No. xv, p. 263.
[2] Med. Chir. Trans. vol. vi, second series.

particulars, but it 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 or colour, and 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 acuminated, 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 maining 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 clearly 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

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[1] British and Foreign Medical Review, No. ix.

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

the system, may be more or less severe, but it 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 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.

3. 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 this view, 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 pre-

vious infection, yet 15,000 had the disease afresh, 12,000 took it imperfectly, and 21,000 not at all; and of this last number, 700 contracted the disease on a second revaccination, whilst 3,000 others escaped.[1] 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 revaccinated, 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 so 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 chiefly 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 propor-

[1] These results occurred in the Prussian armies up to 1833. See M'Cormac's *Methodus Medendi*, p. 72.

tion 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 stage, 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 genuine 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 products 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 from the arms of their

[1] Med. Gaz., vol. xiii, p. 441.

[2] On Vaccine Inoculation.

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 the operation be 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 disease. Heim attributes great local irritation to the exhaustion of all the vesicles. The lymph of a primary, is correctly 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 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 results of one mode of procedure have 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 of Vaccination, 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 consequently 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. 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

[1] Cyclop. Prac. Medicine.

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 procured 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 a 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 acuminated 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 was 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 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."[2]

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.

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[1] On Variolous Epidemic of Norwich, p. 32.

[2] CAPURON. Tratt. delle Bambini. Ed. Nap. p. 211, 1828.

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.[1] 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 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 Vac-

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[1] Brit. and For. Med. Rev., No. xviii, p. 353.

cination 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. We have, in our own practice, seen the effects delayed as late as the ninth day, owing, as we thought, 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

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

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

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

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[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.

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;[1] and Spooner,[2] 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."[3]

Many accurate observers, on the other hand, are of opinion, that distance of time impresses no modification on the anti-variolous 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,

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[1] The Principles of Midwifery. Sixth Edition. London: 1824.

[2] Prov. Med. and Surg. Journ., July 1850.

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

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 secondary 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

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

the observation of Dr. John Thomson,[1] 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*,[2] 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 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,[3] 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 Roberton 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 obviate 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.

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[1] On Varioloid Diseases. [2] Third Edition, p. 798.

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

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 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

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[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.

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 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 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 characteristics.[2] 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.[3] 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.

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

[2] See Brit. and For. Med. Rev.; and Dublin Med. Press, Aug. 1839.

[3] See Brit. and For. Med. Rev. No. xvii, p. 85.

It may here be mentioned that, in describing certain peculiarities of the disease in the cow, Ceely[1] 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.[2] 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 specific febrileirritation, resulting from the effects of the vaccine virus on the constitution. And, further, if the doctrine of M. Delfraysse 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

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[1] 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.

[2] Dublin Medical Press, Nov. 6, 1850, p. 294.

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	——	858	9
Pioneer corps	——	647	1

Similar results were observed in India, and other British colonies; 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 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

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

by Ryan, cannot, at all events, do any harm. The operation itself is done variously. Some recommend a sharp, 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 eligible 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 (*variolæ 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 conta-

[1] Willan on Vaccine Inoculation. 1806.

minated 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 if applied 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 enongh 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 cotemporaneously affected with Cow-pock and Small-pox at the Children's 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 in 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 the 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

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

[2] Med. Chir. Trans., vol. x.

might farther refer to the vast saving of human life, consequent on the introduction of Cow-pock into Sweden and Prussia.[1]

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 of Small-pox contagion is so strong as to be absolutely beyond the protective influence of the variolo-vaccine virus, imparted in any shape whatever. 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 performed ? 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 suc-

[1] Ed. Med. and Surg. Jour., vol. xxvi, p. 171.

ceeds, 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 malady, 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 about one-half of all the cases enumerated, the system was perfectly proof against the secondary infection, and Revaccination entirely or partially 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 usualeffects 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 virus, 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 clearly 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 Cowpock, 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 admits also, that a properly vaccinated person has always a milder form

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[1] Vol. lxiv. [2] Med.-Chir. Rev., July 1844.

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 contagion. 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 necessary 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, 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 trial. 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 this physician, 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

[1] Dublin Quarterly Journal, 1846.

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 practised, it appears that the opinions of different observers are too discrepant, to enable us to deduce from them any general rule of practice. Five, seven, ten, fifteen and twenty years have been respectively assigned as the limit of the protective influence; but, even granting that this limitation really 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 my 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 sanatory 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 some-

thing 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 an alleged tendency in 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 that temporary tendency to increased diffusion, at distant and uncertain periods of time, which characterizes all epidemic 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 would prove effectual in most constitutions, not inherently insusceptible of protection, by any means whatever.

P.S. In confirmation of what has been said as to the neglect of Vaccination, at page 38, and its effect in producing an increase of Small pox, I can refer to an interesting Report on Cholera and Small-pox, in the island of Guernsey in 1849, drawn up by Drs. Hoskins and Mansell; from which it appears that, out of 2,500 cases of Small-pox, three-fourths occurred in persons unprotected by vaccine, the remaining fourth being, probably, only partially protected, from Vaccination having been performed by incompetent hands. It further appears, that 1,500 persons, out of a population of 15,000, had not been vaccinated at all (pp. 18-19).

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