

**I. An Inquiry Into the Causes and Effects of the  
Variolæ Vaccinæ, Or Cow-Pox. 1798**

Edward Jenner (1749–1823). The Three Original Publications  
on Vaccination Against Smallpox.  
The Harvard Classics. 1909–14.

THE DEVIATION of man from the state in which he was originally placed by nature seems to have proved to him a prolific source of diseases. From the love of splendour, from the indulgences of luxury, and from his fondness for amusement he has familiarised himself with a great number of animals, which may not originally have been intended for his associates.

The wolf, disarmed of ferocity, is now pillowed in the lady's lap.<sup>1)</sup> The cat, the little tiger of our island, whose natural home is the forest, is equally domesticated and caressed. The cow, the hog, the sheep, and the horse, are all, for a variety of purposes, brought under his care and dominion.

There is a disease to which the horse, from his state of domestication, is frequently subject. The farriers have called it *the grease*. It is an inflammation and swelling in the heel, from which issues matter possessing properties of a very peculiar kind, which seems capable of generating a disease in the human body (after it has undergone the modification which I shall presently speak of), which bears so strong a resemblance to the smallpox that I think it highly probable it may be the source of the disease.

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1) The late Mr. John Hunter proved, by experiments, that the dog is the wolf in a degenerate state.

In this dairy country a great number of cows are kept, and the office of milking is performed indiscriminately by men and maid servants. One of the former having been appointed to apply dressings to the heels of a horse affected with the grease, and not paying due attention to cleanliness, incautiously bears his part in milking the cows, with some particles of the infectious matter adhering to his fingers. When this is the case, it commonly happens that a disease is communicated to the cows, and from the cows to the dairymaids, which spreads through the farm until the most of the cattle and domestics feel its unpleasant consequences. This disease has obtained the name of the cow-pox. It appears on the nipples of the cows in the form of irregular pustules. At their first appearance they are commonly of a palish blue, or rather of a colour somewhat approaching to livid, and are surrounded by an erysipelatous inflammation. These pustules, unless a timely remedy be applied, frequently degenerate into phagedenic ulcers, which prove extremely troublesome.<sup>2)</sup> The animals become indisposed, and the secretion of milk is much lessened. Inflamed spots now begin to appear on different parts of the hands of the domestics employed in milking, and sometimes on the wrists, which quickly run on to suppuration, first assuming the appearance of the small vesications produced by a burn. Most commonly they appear about the joints of the fingers and at their extremities; but whatever parts are affected, if the situation will admit, these superficial suppurations put on a circular form, with their edges more elevated than their centre, and of a colour distantly approaching to blue. Absorption takes place, and tumours appear in each axilla. The system becomes affected

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2) They who attend sick cattle in this country find a speedy remedy for stopping the progress of this complaint in those applications which act chemically upon the morbid matter, such as the solutions of the vitriolum zinci and the vitriolum cupri, etc.

— the pulse is quickened; and shiverings, succeeded by heat, with general lassitude and pains about the loins and limbs, with vomiting, come on. The head is painful, and the patient is now and then even affected with delirium. These symptoms, varying in their degrees of violence, generally continue from one day to three or four, leaving ulcerated sores about the hands, which, from the sensibility of the parts, are very troublesome, and commonly heal slowly, frequently becoming phagedenic, like those from whence they sprung. The lips, nostrils, eyelids, and other parts of the body are sometimes affected with sores; but these evidently arise from their being heedlessly rubbed or scratched with the patient's infected fingers. No eruptions on the skin have followed the decline of the feverish symptoms in any instance that has come under my inspection, one only excepted, and in this case a very few appeared on the arms: they were very minute, of a vivid red colour, and soon died away without advancing to maturation; so that I cannot determine whether they had any connection with the preceding symptoms.

Thus the disease makes its progress from the horse<sup>3)</sup> to the nipple of the cow, and from the cow to the human subject.

Morbid matter of various kinds, when absorbed into the system, may produce effects in some degree similar; but what renders the cow-pox virus so extremely singular is that the person who has been thus affected is forever after secure from the infection of the small-pox; neither exposure to the variolous effluvia, nor the insertion of the matter into the skin, producing this distemper.

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3) Jenner's conclusion that "grease" and cow-pox were the same disease has since been proved erroneous; but this error has not invalidated his main conclusion as to the relation of cow-pox and smallpox.—EDITOR.

In support of so extraordinary a fact, I shall lay before my reader a great number of instances.<sup>4)</sup>

CASE I. — Joseph Merret, now an under gardener to the Earl of Berkeley, lived as a servant with a farmer near this place in the year 1770, and occasionally assisted in milking his master's cows. Several horses belonging to the farm began to have sore heels, which Merret frequently attended. The cows soon became affected with the cow-pox, and soon after several sores appeared on his hands. Swellings and stiffness in each axilla followed, and he was so much indisposed for several days as to be incapable of pursuing his ordinary employment. Previously to the appearance of the distemper among the cows there was no fresh cow brought into the farm, nor any servant employed who was affected with the cow-pox.

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4) It is necessary to observe that pustulous sores frequently appear spontaneously on the nipples of cows, and instances have occurred, though very rarely, of the hands of the servants employed in milking being affected with sores in consequence, and even of their feeling an indisposition from absorption. These pustules are of a much milder nature than those which arise from that contagion which constitutes the true cow-pox. They are always free from the bluish or livid tint so conspicuous in the pustules in that disease. No erysipelas attends them, nor do they shew any phagedenic disposition as in the other case, but quickly terminate in a scab without creating any apparent disorder in the cow. This complaint appears at various seasons of the year, but most commonly in the spring, when the cows are first taken from their winter food and fed with grass. It is very apt to appear also when they are suckling their young. But this disease is not to be considered as similar in any respect to that of which I am treating, as it is incapable of producing any specific effects on the human constitution. However, it is of the greatest consequence to point it out here, lest the want of discrimination should occasion an idea of security from the infection of the smallpox, which might prove delusive.

In April, 1795, a general inoculation taking place here, Merret was inoculated with his family; so that a period of twenty-five years had elapsed from his having the cow-pox to this time. However, though the variolous matter was repeatedly inserted into his arm, I found it impracticable to infect him with it; an efflorescence only, taking on an erysipelatous look about the centre, appearing on the skin near the punctured parts. During the whole time that his family had the smallpox, one of whom had it very full, he remained in the house with them, but received no injury from exposure to the contagion.

It is necessary to observe that the utmost care was taken to ascertain, with the most scrupulous precision, that no one whose case is here adduced had gone through the smallpox previous to these attempts to produce that disease.

Had these experiments been conducted in a large city, or in a populous neighbourhood, some doubts might have been entertained; but here, where population is thin, and where such an event as a person's having had the smallpox is always faithfully recorded, no risk of inaccuracy in this particular can arise.

CASE II. — Sarah Portlock, of this place, was infected with the cow-pox when a servant at a farmer's in the neighbourhood, twenty-seven years ago.<sup>5)</sup>

In the year 1792, conceiving herself, from this circumstance, secure from the infection of the smallpox, she

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5) I have purposely selected several cases in which the disease had appeared at a very distant period previous to the experiments made with variolous matter, to shew that the change produced in the constitution is not affected by time.

nursed one of her own children who had accidentally caught the disease, but no indisposition ensued. During the time she remained in the infected room, variolous matter was inserted into both her arms, but without any further effect than in the preceding case.

CASE III. — John Phillips, a tradesman of this town, had the cow-pox at so early a period as nine years of age. At the age of sixty-two I inoculated him, and was very careful in selecting matter in its most active state. It was taken from the arm of a boy just before the commencement of the eruptive fever, and instantly inserted. It very speedily produced a sting-like feel in the part. An efflorescence appeared, which on the fourth day was rather extensive, and some degree of pain and stiffness were felt about the shoulder: but on the fifth day these symptoms began to disappear, and in a day or two after went entirely off, without producing any effect on the system.

CASE IV.—Mary Barge, of Woodford, in this parish, was inoculated with variolous matter in the year 1791. An efflorescence of a palish red colour soon appeared about the parts where the matter was inserted, and spread itself rather extensively, but died away in a few days without producing any variolous symptoms.<sup>6)</sup>

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6) It is remarkable that variolous matter, when the system is disposed to reject it, should excite inflammation on the part to which it is applied more speedily than when it produces the smallpox. Indeed, it becomes almost a criterion by which we can determine whether the infection will be received or not. It seems as if a change, which endures through life, had been produced in the action, or disposition to action, in the vessels of the skin; and it is remarkable, too, that whether this change has been effected by the smallpox or the cow-pox that the disposition to sudden cuticular inflammation is the same on the application of variolous matter.

She has since been repeatedly employed as a nurse to smallpox patients, without experiencing any ill consequences. This woman had the cow-pox when she lived in the service of a farmer in this parish thirty-one years before.

CASE V.—Mrs. H——, a respectable gentlewoman of this town, had the cow-pox when very young. She received the infection in rather an uncommon manner: it was given by means of her handling some of the same utensils<sup>7)</sup> which were in use among the servants of the family, who had the disease from milking infected cows. Her hands had many of the cow-pox sores upon them, and they were communicated to her nose, which became inflamed and very much swollen. Soon after this event Mrs. H—— was exposed to the contagion of the smallpox, where it was scarcely possible for her to have escaped, had she been susceptible of it, as she regularly attended a relative who had the disease in so violent a degree that it proved fatal to him.

In the year 1778 the smallpox prevailed very much at Berkeley, and Mrs. H——, not feeling perfectly satisfied respecting her safety (no indisposition having followed her exposure to the smallpox), I inoculated her with active variolous matter. The same appearance followed as in the preceding cases—an efflorescence on the arm without any effect on the constitution.

CASE VI.—It is a fact so well known among our dairy farmers that those who have had the smallpox either escape the cow-pox or are disposed to have it slightly, that as soon as the complaint shews itself among the cattle, assistants are

7) When the cow-pox has prevailed in the dairy, it has often been communicated to those who have not milked the cows, by the handle of the milk pail.

procured, if possible, who are thus rendered less susceptible of it, otherwise the business of the farm could scarcely go forward.

In the month of May, 1796, the cow-pox broke out at Mr. Baker's, a farmer who lives near this place. The disease was communicated by means of a cow which was purchased in an infected state at a neighbouring fair, and not one of the farmer's cows (consisting of thirty) which were at that time milked escaped the contagion. The family consisted of a man servant, two dairymaids, and a servant boy, who, with the farmer himself, were twice a day employed in milking the cattle. The whole of this family, except Sarah Wynne, one of the dairymaids, had gone through the smallpox. The consequence was that the farmer and the servant boy escaped the infection of the cow-pox entirely, and the servant man and one of the maid servants had each of them nothing more than a sore on one of their fingers, which produced no disorder in the system. But the other dairymaid, Sarah Wynne, who never had the smallpox, did not escape in so easy a manner. She caught the complaint from the cows, and was affected with the symptoms described on page 146 in so violent a degree that she was confined to her bed, and rendered incapable for several days of pursuing her ordinary vocations in the farm.

March 28th, 1797, I inoculated this girl and carefully rubbed the variolous matter into two slight incisions made upon the left arm. A little inflammation appeared in the usual manner around the parts where the matter was inserted, but so early as the fifth day it vanished entirely without producing any effect on the system.

CASE VII.—Although the preceding history pretty clearly

evinces that the constitution is far less susceptible of the contagion of the cow-pox after it has felt that of the smallpox, and although in general, as I have observed, they who have had the smallpox, and are employed in milking cows which are infected with the cow-pox, either escape the disorder, or have sores on the hands without feeling any general indisposition, yet the animal economy is subject to some variation in this respect, which the following relation will point out:

In the summer of the year 1796 the cow-pox appeared at the farm of Mr. Andrews, a considerable dairy adjoining to the town of Berkeley. It was communicated, as in the preceding instance, by an infected cow purchased at a fair in the neighbourhood. The family consisted of the farmer, his wife, two sons, a man and a maid servant; all of whom, except the farmer (who was fearful of the consequences), bore a part in milking the cows. The whole of them, exclusive of the man servant, had regularly gone through the smallpox; but in this case no one who milked the cows escaped the contagion. All of them had sores upon their hands, and some degree of general indisposition, preceded by pains and tumours in the axillæ: but there was no comparison in the severity of the disease as it was felt by the servant man, who had escaped the smallpox, and by those of the family who had not, for, while he was confined to his bed, they were able, without much inconvenience, to follow their ordinary business.

February the 13th, 1797, I availed myself of an opportunity of inoculating William Rodway, the servant man above alluded to. Variolous matter was inserted into both his arms: in the right, by means of superficial incisions, and into the left by slight punctures into the cutis. Both were

perceptibly inflamed on the third day. After this the inflammation about the punctures soon died away, but a small appearance of erysipelas was manifest about the edges of the incisions till the eighth day, when a little uneasiness was felt for the space of half an hour in the right axilla. The inflammation then hastily disappeared without producing the most distant mark of affection of the system.

CASE VIII.—Elizabeth Wynne, aged fifty-seven, lived as a servant with a neighbouring farmer thirty-eight years ago. She was then a dairymaid, and the cow-pox broke out among the cows. She caught the disease with the rest of the family, but, compared with them, had it in a very slight degree, one very small sore only breaking out on the little finger of her left hand, and scarcely any perceptible indisposition following it.

As the malady had shewn itself in so slight a manner, and as it had taken place at so distant a period of her life, I was happy with the opportunity of trying the effects of variolous matter upon her constitution, and on the 28th of March, 1797, I inoculated her by making two superficial incisions on the left arm, on which the matter was cautiously rubbed. A little efflorescence soon appeared, and a tingling sensation was felt about the parts where the matter was inserted until the third day, when both began to subside, and so early as the fifth day it was evident that no indisposition would follow.

CASE IX.—Although the cow-pox shields the constitution from the smallpox, and the smallpox proves a protection against its own future poison, yet it appears that the human body is again and again susceptible of the infectious matter of the cow-pox, as the following history will demonstrate.

William Smith, of Pyrton in this parish, contracted this disease when he lived with a neighbouring farmer in the year 1780. One of the horses belonging to the farm had sore heels, and it fell to his lot to attend him. By these means the infection was carried to the cows, and from the cows it was communicated to Smith. On one of his hands were several ulcerated sores, and he was affected with such symptoms as have been before described.

In the year 1791 the cow-pox broke out at another farm where he then lived as a servant, and he became affected with it a second time; and in the year 1794 he was so unfortunate as to catch it again. The disease was equally as severe the second and third time as it was on the first.<sup>8)</sup>

In the spring of the year 1795 he was twice inoculated, but no affection of the system could be produced from the variolous matter; and he has since associated with those who had the smallpox in its most contagious state without feeling any effect from it.

CASE X.—Simon Nichols lived as a servant with Mr. Bromedge, a gentleman who resides on his own farm in this parish, in the year 1782. He was employed in applying dressings to the sore heels of one of his master's horses, and at the same time assisted in milking the cows. The cows became affected in consequence, but the disease did not shew itself on their nipples till several weeks after he had begun to dress the horse. He quitted Mr. Bromedge's service, and went to another farm without any sores upon him; but here his hands soon began to be affected in the common way, and he

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8) This is not the case in general—a second attack is commonly very slight, and so, I am informed, it is among the cows.

was much indisposed with the usual symptoms. Concealing the nature of the malady from Mr. Cole, his new master, and being there also employed in milking, the cow-pox was communicated to the cows.

Some years afterward Nichols was employed in a farm where the smallpox broke out, when I inoculated him with several other patients, with whom he continued during the whole time of their confinement. His arm inflamed, but neither the inflammation nor his associating with the inoculated family produced the least effect upon his constitution.

CASE XI.—William Stinchcomb was a fellow servant with Nichols at Mr. Bromedge's farm at the time the cattle had the cow-pox, and he was, unfortunately, infected by them. His left hand was very severely affected with several corroding ulcers, and a tumour of considerable size appeared in the axilla of that side. His right hand had only one small tumour upon it, and no tumour discovered itself in the corresponding axilla.

In the year 1792 Stinchcomb was inoculated with variolous matter, but no consequences ensued beyond a little inflammation in the arm for a few days. A large party were inoculated at the same time, some of whom had the disease in a more violent degree than is commonly seen from inoculation. He purposely associated with them, but could not receive the smallpox.

During the sickening of some of his companions their symptoms so strongly recalled to his mind his own state when sickening with the cow-pox that he very pertinently remarked their striking similarity.

CASE XII.—The paupers of the village of Tortworth, in this county, were inoculated by Mr. Henry Jenner, Surgeon, of Berkeley, in the year 1795. Among them, eight patients presented themselves who had at different periods of their lives had the cow-pox. One of them, Hester Walkley, I attended with that disease when she lived in the service of a farmer in the same village in the year 1782; but neither this woman, nor any other of the patients who had gone through the cow-pox, received the variolous infection either from the arm or from mixing in the society of the other patients who were inoculated at the same time. This state of security proved a fortunate circumstance, as many of the poor women were at the same time in a state of pregnancy.

CASE XIII.—One instance has occurred to me of the system being affected from the matter issuing from the heels of horses, and of its remaining afterwards unsusceptible of the variolous contagion; another, where the smallpox appeared obscurely; and a third, in which its complete existence was positively ascertained.

First, Thomas Pearce is the son of a smith and farrier near to this place. He never had the cow-pox; but, in consequence of dressing horses with sore heels at his father's, when a lad, he had sores on his fingers which suppurated, and which occasioned a pretty severe indisposition. Six years afterwards I inserted variolous matter into his arm repeatedly, without being able to produce any thing more than slight inflammation, which appeared very soon after the matter was applied, and afterwards I exposed him to the contagion of the smallpox with as little effect.<sup>9)</sup>

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9) It is a remarkable fact, and well known to many, that we are frequently

CASE XIV.—Secondly, Mr. James Cole, a farmer in this parish, had a disease from the same source as related in the preceding case, and some years after was inoculated with variolous matter. He had a little pain in the axilla and felt a slight indisposition for three or four hours. A few eruptions shewed themselves on the forehead, but they very soon disappeared without advancing to maturation.

CASE XV.—Although in the former instances the system seemed to be secured, or nearly so, from variolous infection, by the absorption of matter from the sores produced by the diseased heels of horses, yet the following case decisively proves that this cannot be entirely relied upon until a disease has been generated by the morbid matter from the horse on the nipple of the cow, and passed through that medium to the human subject.

Mr. Abraham Riddiford, a farmer at Stone in this parish, in consequence of dressing a mare that had sore heels, was affected with very painful sores in both his hands, tumours in each axilla, and severe and general indisposition. A surgeon in the neighbourhood attended him, who knowing the similarity between the appearance of the sores upon his hands and those produced by the cow-pox, and being acquainted also with the effects of that disease on the human constitution, assured him that he never need to fear the infection of the smallpox; but this assertion proved fallacious, for, on being exposed to the infection upwards of twenty

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foiled in our endeavours to communicate the smallpox by inoculation to blacksmiths, who in the country are farriers. They often, as in the above instance, either resist the contagion entirely, or have the disease anomalously. Shall we not be able to account for this on a rational principle?

years afterwards, he caught the disease, which took its regular course in a very mild way. There certainly was a difference perceptible, although it is not easy to describe it, in the general appearance of the pustules from that which we commonly see. Other practitioners who visited the patient at my request agreed with me in this point, though there was no room left for suspicion as to the reality of the disease, as I inoculated some of his family from the pustules, who had the smallpox, with its usual appearances, in consequence.

CASE XVI.—Sarah Nelmes, a dairymaid at a farmer's near this place, was infected with the cow-pox from her master's cows in May, 1796. She received the infection on a part of her hand which had been previously in a slight degree injured by a scratch from a thorn. A large pustulous sore and the usual symptoms accompanying the disease were produced in consequence. The pustule was so expressive of the true character of the cow-pox, as it commonly appears upon the hand, that I have given a representation of it in the annexed plate. [In original.] The two small pustules on the wrists arose also from the application of the virus to some minute abrasions of the cuticle, but the livid tint, if they ever had any, was not conspicuous at the time I saw the patient. The pustule on the forefinger shews the disease in an earlier stage. It did not actually appear on the hand of this young woman, but was taken from that of another, and is annexed for the purpose of representing the malady after it has newly appeared.

CASE XVII.—The more accurately to observe the progress of the infection I selected a healthy boy, about eight years old, for the purpose of inoculation for the cow-pox. The

matter was taken from a sore on the hand of a dairymaid, <sup>10)</sup> who was infected by her master's cows, and it was inserted, on the 14th of May, 1796, into the arm of the boy by means of two superficial incisions, barely penetrating the cutis, each about half an inch long.

On the seventh day he complained of uneasiness in the axilla, and on the ninth he became a little chilly, lost his appetite, and had a slight headache. During the whole of this day he was perceptibly indisposed, and spent the night with some degree of restlessness, but on the day following he was perfectly well.

The appearance of the incisions in their progress to a state of maturation were much the same as when produced in a similar manner by variolous matter. The only difference which I perceived was in the state of the limpid fluid arising from the action of the virus, which assumed rather a darker hue, and in that of the efflorescence spreading round the incisions, which had more of an erysipelatous look than we commonly perceive when variolous matter has been made use of in the same manner; but the whole died away (leaving on the inoculated parts scabs and subsequent eschars) without giving me or my patient the least trouble.

In order to ascertain whether the boy, after feeling so slight an affection of the system from the cow-pox virus, was secure from the contagion of the smallpox, he was inoculated the 1st of July following with variolous matter, immediately taken from a pustule. Several slight punctures and incisions were made on both his arms, and the matter was carefully inserted, but no disease followed. The same appearances were observable on the arms as we commonly see when a

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10) From the sore on the hand of Sarah Nelmes. See the preceding case.

patient has had variolous matter applied, after having either the cow-pox or smallpox. Several months afterwards he was again inoculated with variolous matter, but no sensible effect was produced on the constitution.

Here my researches were interrupted till the spring of the year 1798, when, from the wetness of the early part of the season, many of the farmers' horses in this neighbourhood were affected with sore heels, in consequence of which the cow-pox broke out among several of our dairies, which afforded me an opportunity of making further observations upon this curious disease.

A mare, the property of a person who keeps a dairy in a neighbouring parish, began to have sore heels the latter end of the month of February, 1798, which were occasionally washed by the servant men of the farm, Thomas Virgoe, William Wherret, and William Haynes, who in consequence became affected with sores in their hands, followed by inflamed lymphatic glands in the arms and axillæ, shiverings succeeded by heat, lassitude, and general pains in the limbs. A single paroxysm terminated the disease; for within twenty-four hours they were free from general indisposition, nothing remaining but the sores on their hands. Haynes and Virgoe, who had gone through the smallpox from inoculation, described their feelings as very similar to those which affected them on sickening with that malady. Wherret never had had the smallpox. Haynes was daily employed as one of the milkers at the farm, and the disease began to shew itself among the cows about ten days after he first assisted in washing the mare's heels. Their nipples became sore in the usual way, with bluish pustules; but as remedies were early applied, they did not ulcerate to any extent.

CASE XVIII.—John Baker, a child of five years old, was inoculated March 16, 1798, with matter taken from a pustule on the hand of Thomas Virgoe, one of the servants who had been infected from the mare's heels. He became ill on the sixth day with symptoms similar to those excited by cow-pox matter. On the eighth day he was free from indisposition.

There was some variation in the appearance of the pustule on the arm. Although it somewhat resembled a smallpox pustule, yet its similitude was not so conspicuous as when excited by matter from the nipple of the cow, or when the matter has passed from thence through the medium of the human subject.

This experiment was made to ascertain the progress and subsequent effects of the disease when thus propagated. We have seen that the virus from the horse, when it proves infectious to the human subject, is not to be relied upon as rendering the system secure from variolous infection, but that the matter produced by it upon the nipple of the cow is perfectly so. Whether its passing from the horse through the human constitution, as in the present instance, will produce a similar effect, remains to be decided. This would now have been effected, but the boy was rendered unfit for inoculation from having felt the effects of a contagious fever in a workhouse soon after this experiment was made.

CASE XIX.—William Summers, a child of five years and a half old, was inoculated the same day with Baker, with matter taken from the nipples of one of the infected cows, at the farm alluded to. He became indisposed on the sixth day, vomited once, and felt the usual slight symptoms till the eighth day, when he appeared perfectly well. The progress of the pustule, formed by the infection of the virus, was similar

to that noticed in Case XVII, with this exception, its being free from the livid tint observed in that instance.

CASE XX.—From William Summers the disease was transferred to William Pead, a boy of eight years old, who was inoculated March 28th. On the sixth day he complained of pain in the axilla, and on the seventh was affected with the common symptoms of a patient sickening with the smallpox from inoculation, which did not terminate till the third day after the seizure. So perfect was the similarity to the variolous fever that I was induced to examine the skin, conceiving there might have been some eruptions, but none appeared. The efflorescent blush around the part punctured in the boy's arm was so truly characteristic of that which appears on variolous inoculation that I have given a representation of it. [In original.] The drawing was made when the pustule was beginning to die away and the areola retiring from the centre.

CASE XXI.—April 5th: Several children and adults were inoculated from the arm of William Pead. The greater part of them sickened on the sixth day, and were well on the seventh, but in three of the number a secondary indisposition arose in consequence of an extensive erysipelatous inflammation which appeared on the inoculated arms. It seemed to arise from the state of the pustule, which spread out, accompanied with some degree of pain, to about half the diameter of a sixpence. One of these patients was an infant of half a year old. By the application of mercurial ointment to the inflamed parts (a treatment recommended under similar circumstances in the inoculated smallpox) the complaint subsided without giving much trouble.

Hannah Excell, an healthy girl of seven years old, and one of the patients above mentioned, received the infection from

the insertion of the virus under the cuticle of the arm in three distinct points. The pustules which arose in consequence so much resembled, on the twelfth day, those appearing from the infection of variolous matter, that an experienced inoculator would scarcely have discovered a shade of difference at that period. Experience now tells me that almost the only variation which follows consists in the pustulous fluids remaining limpid nearly to the time of its total disappearance; and not, as in the direct smallpox, becoming purulent.

CASE XXII.—From the arm of this girl matter was taken and inserted April 12th into the arms of John Marklove, one year and a half old, Robert F. Jenner, eleven months old, Mary Pead, five years old, and Mary James, six years old.

Among these, Robert F. Jenner did not receive the infection. The arms of the other three inflamed properly and began to affect the system in the usual manner; but being under some apprehensions from the preceding cases that a troublesome erysipeals might arise, I determined on making an experiment with the view of cutting off its source. Accordingly, after the patients had felt an indisposition of about twelve hours, I applied in two of these cases out of the three, on the vesicle formed by the virus, a little mild caustic, composed of equal parts of quick-lime and soap, and suffered it to remain on the part six hours.<sup>11)</sup> It seemed to give the children but little uneasiness, and effectually answered my intention in preventing the appearance of erysipelas. Indeed, it seemed to do more, for in half an hour after its application the indisposition of the children ceased.<sup>12)</sup> These precautions

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11) Perhaps a few touches with the lapis septicus would have proved equally efficacious.

12) What effect would a similar treatment produce in inoculation for the smallpox?

were perhaps unnecessary, as the arm of the third child, Mary Pead, which was suffered to take its common course, scabbed quickly, without any erysipelas.

CASE XXIII.—From this child's arm matter was taken and transferred to that of J. Barge, a boy of seven years old. He sickened on the eighth day, went through the disease with the usual slight symptoms, and without any inflammation on the arm beyond the common efflorescence surrounding the pustule, an appearance so often seen in inoculated smallpox.

After the many fruitless attempts to give the smallpox to those who had had the cow-pox, it did not appear necessary, nor was it convenient to me, to inoculate the whole of those who had been the subjects of these late trials; yet I thought it right to see the effects of variolous matter on some of them, particularly William Summers, the first of these patients who had been infected with matter taken from the cow. He was, therefore, inoculated with variolous matter from a fresh pustule; but, as in the preceding cases, the system did not feel the effects of it in the smallest degree. I had an opportunity also of having this boy and William Pead inoculated by my nephew, Mr. Henry Jenner, whose report to me is as follows: "I have inoculated Pead and Barge, two of the boys whom you lately infected with the cow-pox. On the second day the incisions were inflamed and there was a pale inflammatory stain around them. On the third day these appearances were still increasing and their arms itched considerably. On the fourth day the inflammation was evidently subsiding, and on the sixth day it was scarcely perceptible. No symptom of indisposition followed.

"To convince myself that the variolous matter made use of was in a perfect state I at the same time inoculated a patient

with some of it who never had gone through the cow-pox, and it produced the smallpox in the usual regular manner.”

These experiments afforded me much satisfaction; they proved that the matter, in passing from one human subject to another, through five gradations, lost none of its original properties, J. Barge being the fifth who received the infection successively from William Summers, the boy to whom it was communicated from the cow.

I shall now conclude this inquiry with some general observations on the subject, and on some others which are interwoven with it.

Although I presume it may be unnecessary to produce further testimony in support of my assertion “that the cow-pox protects the human constitution from the infection of the smallpox,” yet it affords me considerable satisfaction to say that Lord Somerville, the President of the Board of Agriculture, to whom this paper was shewn by Sir Joseph Banks, has found upon inquiry that the statements were confirmed by the concurring testimony of Mr. Dolland, a surgeon, who resides in a dairy country remote from this, in which these observations were made. With respect to the opinion adduced “that the source of the infection is a peculiar morbid matter arising in the horse,” although I have not been able to prove it from actual experiments conducted immediately under my own eye, yet the evidence I have adduced appears sufficient to establish it.

They who are not in the habit of conducting experiments may not be aware of the coincidence of circumstances necessary for their being managed so as to prove perfectly decisive; nor how often men engaged in professional pursuits

are liable to interruptions which disappoint them almost at the instant of their being accomplished: however, I feel no room for hesitation respecting the common origin of the disease, being well convinced that it never appears among the cows (except it can be traced to a cow introduced among the general herd which has been previously infected, or to an infected servant) unless they have been milked by some one who, at the same time, has the care of a horse affected with diseased heels.

The spring of the year 1797, which I intended particularly to have devoted to the completion of this investigation, proved, from its dryness, remarkably adverse to my wishes; for it frequently happens, while the farmers' horses are exposed to the cold rains which fall at that season, that their heels become diseased, and no cow-pox then appeared in the neighbourhood.

The active quality of the virus from the horses' heels is greatly increased after it has acted on the nipples of the cow, as it rarely happens that the horse affects his dresser with sores, and as rarely that a milkmaid escapes the infection when she milks infected cows. It is most active at the commencement of the disease, even before it has acquired a pus-like appearance; indeed, I am not confident whether this property in the matter does not entirely cease as soon as it is secreted in the form of pus. I am induced to think it does cease,<sup>13)</sup> and that it is the thin, darkish-looking fluid only, oozing from the newly-formed cracks in the heels, similar to what sometimes appears from erysipelalous blisters, which

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13) It is very easy to procure pus from old sores on the heels of horses. This I have often inserted into scratches made with a lancet, on the sound nipples of cows, and have seen no other effects from it than simple inflammation.

gives the disease. Nor am I certain that the nipples of the cows are at all times in a state to receive the infection. The appearance of the disease in the spring and the early part of the summer, when they are disposed to be affected with spontaneous eruptions so much more frequently than at other seasons, induces me to think that the virus from the horse must be received upon them when they are in this state, in order to produce effects: experiments, however, must determine these points. But it is clear that when the cow-pox virus is once generated, that the cows cannot resist the contagion, in whatever state their nipples may chance to be, if they are milked with an infected hand.

Whether the matter, either from the cow or the horse, will affect the sound skin of the human body, I cannot positively determine; probably it will not, unless on those parts where the cuticle is extremely thin, as on the lips, for example. I have known an instance of a poor girl who produced an ulceration on her lip by frequently holding her finger to her mouth to cool the raging of a cow-pox sore by blowing upon it. The hands of the farmers' servants here, from the nature of their employments, are constantly exposed to those injuries which occasion abrasions of the cuticle, to punctures from thorns, and such like accidents; so that they are always in a state to feel the consequence of exposure to infectious matter.

It is singular to observe that the cow-pox virus, although it renders the constitution unsusceptible of the variolous, should nevertheless, leave it unchanged with respect to its own action. I have already produced an instance<sup>14)</sup> to point out this, and shall now corroborate it with another.

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14) See Case IX.

Elizabeth Wynne, who had the cow-pox in the year 1759, was inoculated with variolous matter, without effect, in the year 1797, and again caught the cow-pox in the year 1798. When I saw her, which was on the eighth day after she received the infection, I found her affected with general lassitude, shiverings, alternating with heat, coldness of the extremities, and a quick and irregular pulse. These symptoms were preceded by a pain in the axilla. On her hand was one large pustulous sore, which resembled that delineated in Plate No. 1. (Plate appears in original.)

It is curious also to observe that the virus, which with respect to its effects is undetermined and uncertain previously to its passing from the horse through the medium of the cow, should then not only become more active, but should invariably and completely possess those specific properties which induce in the human constitution symptoms similar to those of the variolous fever, and effect in it that peculiar change which for ever renders it unsusceptible of the variolous contagion.

May it not then be reasonably conjectured that the source of the smallpox is morbid matter of a peculiar kind, generated by a disease in the horse, and that accidental circumstances may have again and again arisen, still working new changes upon it until it has acquired the contagious and malignant form under which we now commonly see it making its devastations amongst us? And, from a consideration of the change which the infectious matter undergoes from producing a disease on the cow, may we not conceive that many contagious diseases, now prevalent among us, may owe their present appearance not to a simple, but to a compound, origin? For example, is it difficult to imagine that the measles, the scarlet fever, and the ulcerous sore throat with a

spotted skin have all sprung from the same source, assuming some variety in their forms according to the nature of their new combinations? The same question will apply respecting the origin of many other contagious diseases which bear a strong analogy to each other.

There are certainly more forms than one, without considering the common variation between the confluent and distinct, in which the smallpox appears in what is called the natural way. About seven years ago a species of smallpox spread through many of the towns and villages of this part of Gloucestershire: it was of so mild a nature that a fatal instance was scarcely ever heard of, and consequently so little dreaded by the lower orders of the community that they scrupled not to hold the same intercourse with each other as if no infectious disease had been present among them. I never saw nor heard of an instance of its being confluent. The most accurate manner, perhaps, in which I can convey an idea of it is by saying that had fifty individuals been taken promiscuously and infected by exposure to this contagion, they would have had as mild and light a disease as if they had been inoculated with variolous matter in the usual way. The harmless manner in which it shewed itself could not arise from any peculiarity either in the season or the weather, for I watched its progress upwards of a year without perceiving any variation in its general appearance. I consider it then as a *variety* of the smallpox.<sup>15)</sup>

In some of the preceding cases I have noticed the attention

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15) My friend, Dr. Hicks, of Bristol, who, during the prevalence of this distemper, was resident at Gloucester, and physician to the hospital there (where it was seen soon after its first appearance in this country), had opportunities of making numerous observations upon it, which it is his intention to communicate to the public.

that was paid to the state of the variolous matter previous to the experiment of inserting it into the arms of those who had gone through the cow-pox. This I conceived to be of great importance in conducting these experiments, and, were it always properly attended to by those who inoculate for the smallpox, it might prevent much subsequent mischief and confusion. With the view of enforcing so necessary a precaution I shall take the liberty of digressing so far as to point out some unpleasant facts relative to mismanagement in this particular, which have fallen under my own observation.

A medical gentleman (now no more), who for many years inoculated in this neighbourhood, frequently preserved the variolous matter intended for his use on a piece of lint or cotton, which, in its fluid state, was put into a vial, corked, and conveyed into a warm pocket; a situation certainly favourable for speedily producing putrefaction in it. In this state (not unfrequently after it had been taken several days from the pustules) it was inserted into the arms of his patients, and brought on inflammation of the incised parts, swellings of the axillary glands, fever, and sometimes eruptions. But what was this disease? Certainly not the smallpox; for the matter having from putrefaction lost or suffered a derangement in its specific properties, was no longer capable of producing that malady, those who had been inoculated in this manner being as much subject to the contagion of the smallpox as if they had never been under the influence of this artificial disease; and many, unfortunately, fell victims to it, who thought themselves in perfect security. The same unfortunate circumstance of giving a disease, supposed to be the smallpox, with inefficacious variolous matter, having occurred under the direction of some other practitioners within my knowledge, and probably from the same incautious method of securing the variolous matter, I

avail myself of this opportunity of mentioning what I conceive to be of great importance; and, as a further cautionary hint, I shall again digress so far as to add another observation on the subject of inoculation.

Whether it be yet ascertained by experiment that the quantity of variolous matter inserted into the skin makes any difference with respect to the subsequent mildness or violence of the disease, I know not; but I have the strongest reason for supposing that if either the punctures or incisions be made so deep as to go *through* it and wound the adipose membrane, that the risk of bringing on a violent disease is greatly increased. I have known an inoculator whose practice was to cut deep enough (to use his own expression) to see a bit of fat," and there to lodge the matter. The great number of bad cases, independent of inflammations and abscesses on the arms, and the fatality which attended this practice, was almost inconceivable; and I cannot account for it on any other principle than that of the matter being placed in this situation instead of the skin.

It was the practice of another, whom I well remember, to pinch up a small portion of the skin on the arms of his patients and to pass through it a needle, with a thread attached to it previously dipped in variolous matter. The thread was lodged in the perforated part, and consequently left in contact with the cellular membrane. This practice was attended with the same ill success as the former. Although it is very improbable that any one would now inoculate in this rude way by design, yet these observations may tend to place a double guard over the lancet, when infants, whose skins are comparatively so very thin, fall under the care of the inoculator.

A very respectable friend of mine, Dr. Hardwicke, of Sodbury in this county, inoculated great numbers of patients previous to the introduction of the more modern method by Sutton, and with such success that a fatal instance occurred as rarely as since that method has been adopted. It was the doctor's practice to make as slight an incision as possible *upon* the skin, and there to lodge a thread saturated with the variolous matter. When his patients became indisposed, agreeably to the custom then prevailing, they were directed to go to bed and were kept moderately warm. Is it not probable then that the success of the modern practice may depend more upon the method of invariably depositing the virus in or upon the skin, than on the subsequent treatment of the disease?

I do not mean to insinuate that exposure to cool air, and suffering the patient to drink cold water when hot and thirsty, may not moderate the eruptive symptoms and lessen the number of pustules; yet, to repeat my former observation, I cannot account for the uninterrupted success, or nearly so, of one practitioner, and the wretched state of the patients under the care of another, where, in both instances, the general treatment did not differ essentially, without conceiving it to arise from the different modes of inserting the matter for the purpose of producing the disease. As it is not the identical matter inserted which is absorbed into the constitution, but that which is, by some peculiar process in the animal economy, generated by it, is it not probable that different parts of the human body may prepare or modify the virus differently? Although the skin, for example, adipose membrane, or mucous membranes are all capable of producing the variolous virus by the stimulus given by the particles originally deposited upon them, yet I am induced to conceive that each of these parts is capable of producing

some variation in the qualities of the matter previous to its affecting the constitution. What else can constitute the difference between the smallpox when communicated casually or in what has been termed the natural way, or when brought on artificially through the medium of the skin?

After all, are the variolous particles, possessing their true specific and contagious principles, ever taken up and conveyed by the lymphatics unchanged into the blood vessels? I imagine not. Were this the case, should we not find the blood sufficiently loaded with them in some stages of the smallpox to communicate the disease by inserting it under the cuticle, or by spreading it on the surface of an ulcer? Yet experiments have determined the impracticability of its being given in this way; although it has been proved that variolous matter, when much diluted with water and applied to the skin in the usual manner, will produce the disease. But it would be digressing beyond a proper boundary to go minutely into this subject here.

At what period the cow-pox was first noticed here is not upon record. Our oldest farmers were not unacquainted with it in their earliest days, when it appeared among their farms without any deviation from the phenomena which it now exhibits. Its connection with the smallpox seems to have been unknown to them. Probably the general introduction of inoculation first occasioned the discovery.

Its rise in this country may not have been of very remote date, as the practice of milking cows might formerly have been in the hands of women only; which I believe is the case now in some other dairy countries, and, consequently, that the cows might not in former times have been exposed to the contagious matter brought by the men servants from the heels

of horses.<sup>16)</sup> Indeed, a knowledge of the source of the infection is new in the minds of most of the farmers in this neighbourhood, but it has at length produced good consequences; and it seems probable, from the precautions they are now disposed to adopt, that the appearance of the cow-pox here may either be entirely extinguished or become extremely rare.

Should it be asked whether this investigation is a matter of mere curiosity, or whether it tends to any beneficial purpose, I should answer that, notwithstanding the happy effects of inoculation, with all the improvements which the practice has received since its first introduction into this country, it not very unfrequently produces deformity of the skin, and sometimes, under the best management, proves fatal.

These circumstances must naturally create in every instance some degree of painful solicitude for its consequences. But as I have never known fatal effects arise from the cow-pox, even when impressed in the most unfavourable manner, producing extensive inflammations and suppurations on the hands; and as it clearly appears that this disease leaves the constitution in a state of perfect security from the infection of the smallpox, may we not infer that a mode of inoculation may be introduced preferable to that at present adopted, especially among those families which, from previous circumstances, we may judge to be predisposed to have the disease unfavourably? It is an excess in the number

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16) I have been informed from respectable authority that in Ireland, although dairies abound in many parts of the island, the disease is entirely unknown. The reason seems obvious. The business of the dairy is conducted by women only. Were the meanest vassal among the men employed there as a milker at a dairy, he would feel his situation unpleasant beyond all endurance.

of pustules which we chiefly dread in the smallpox; but in the cow-pox no pustules appear, nor does it seem possible for the contagious matter to produce the disease from effluvia, or by any other means than contact, and that probably not simply between the virus and the cuticle; so that a single individual in a family might at any time receive it without the risk of infecting the rest or of spreading a distemper that fills a country with terror.

Several instances have come under my observation which justify the assertion that the disease cannot be propagated by effluvia. The first boy whom I inoculated with the matter of cow-pox slept in a bed, while the experiment was going forward, with two children who never had gone through either that disease or the smallpox, without infecting either of them.

A young woman who had the cow-pox to a great extent, several sores which matured having appeared on the hands and wrists, slept in the same bed with a fellow-dairymaid who never had been infected with either the cow-pox or the smallpox, but no indisposition followed.

Another instance has occurred of a young woman on whose hands were several large suppurations from the cow-pox, who was at the same time a daily nurse to an infant, but the complaint was not communicated to the child.

In some other points of view the inoculation of this disease appears preferable to the variolous inoculation.

In constitutions predisposed to scrophula, how frequently we see the inoculated smallpox rouse into activity that distressful malady! This circumstance does not seem to

depend on the manner in which the distemper has shewn itself, for it has as frequently happened among those who have had it mildly as when it has appeared in the contrary way.

There are many who, from some peculiarity in the habit, resist the common effects of variolous matter inserted into the skin, and who are in consequence haunted through life with the distressing idea of being insecure from subsequent infection. A ready mode of dissipating anxiety originating from such a cause must now appear obvious. And, as we have seen that the constitution may at any time be made to feel the febrile attack of cow-pox, might it not, in many chronic diseases, be introduced into the system, with the probability of affording relief, upon well-known physiological principles?

Although I say the system may at any time be made to feel the febrile attack of cow-pox, yet I have a single instance before me where the virus acted locally only, but it is not in the least probable that the same person would resist the action both of the cow-pox virus and the variolous.

Elizabeth Sarfenet lived as a dairymaid at Newpark farm, in this parish. All the cows and the servants employed in milking had the cow-pox; but this woman, though she had several sores upon her fingers, felt no tumours in the axillæ, nor any general indisposition. On being afterwards casually exposed to variolous infection, she had the smallpox in a mild way. Hannah Pick, another of the dairymaids who was a fellow-servant with Elizabeth Sarfenet when the distemper broke out at the farm, was, at the same time, infected; but this young woman had not only sores upon her hands, but felt herself also much indisposed for a day or two. After this, I

made several attempts to give her the smallpox by inoculation, but they all proved fruitless. From the former case then we see that the animal economy is subject to the same laws in one disease as the other.

The following case, which has very lately occurred, renders it highly probable that not only the heels of the horse, but other parts of the body of that animal, are capable of generating the virus which produces the cow-pox.

An extensive inflammation of the erysipelatous kind appeared without any apparent cause upon the upper part of the thigh of a sucking colt, the property of Mr. Millet, a farmer at Rockhampton, a village near Berkeley. The inflammation continued several weeks, and at length terminated in the formation of three or four small abscesses. The inflamed parts were fomented, and dressings were applied by some of the same persons who were employed in milking the cows. The number of cows milked was twenty-four, and the whole of them had the cow-pox. The milkers, consisting of the farmer's wife, a man and a maid servant, were infected by the cows. The man-servant had previously gone through the small-pox, and felt but little of the cow-pox. The servant maid had some years before been infected with the cow-pox, and she also felt it now in a slight degree; but the farmer's wife, who never had gone through either of the diseases, felt its effects very severely.

That the disease produced upon the cows by the colt and from thence conveyed to those who milked them was the *true* and not the *spurious* cow-pox,<sup>17)</sup> there can be scarcely any room for suspicion; yet it would have been more completely

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17) See Note 4, p. 147.

satisfactory had the effects of variolous matter been ascertained on the farmer's wife, but there was a peculiarity in her situation which prevented my making the experiment.

Thus far have I proceeded in an inquiry founded, as it must appear, on the basis of experiment; in which, however, conjecture has been occasionally admitted in order to present to persons well situated for such discussions, objects for a more minute investigation. In the mean time I shall myself continue to prosecute this inquiry, encouraged by the hope of its becoming essentially beneficial to mankind.