

THE HISTORY OF THE PREVENTION OF SMALL-POX.

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THE early history of small-pox is involved in great obscurity, and since the time of Rhazes in the tenth century medical historians have disputed as to both the date and place of its origin. The most generally accepted opinion is that the disease was introduced into Europe by the followers of Mahomet, and tradition dates its origin from the celebrated "War of the Elephant," which took place in the year of the birth of the Prophet, or 569 of our era. The war of the elephant was a religious war of great celebrity in Arabia. Abrahah, an Abyssinian prince and a Christian, built a magnificent church at Sanaa with the idea of attracting to it the Arabian pilgrims from their worship at Mecca. The inhabitants of Mecca secretly defiled this church, and so enraged Abrahah that he determined to destroy the temple at Mecca. In order to effect this purpose he raised a great army, and, mounted on a large elephant, marched on Mecca. The town was in a state of helplessness and its destruction seemed certain, but the story goes that when Abrahah attempted to enter the city the elephant knelt down, then turned round, and refused to advance. At the same time a flock of supernatural birds came flying in from the sea. These birds were black and green in colour, and had white and yellow bills; each of them carried a stone about the size of a pea in its

bill and one in each claw. These stones the birds dropped on the heads of the soldiers of Abrahah's army; the stones pierced the helmets of the soldiers and destroyed the entire army. Other accounts attribute the destruction of the Abyssinian army to a new pestilence, called small-pox, which from that time forward spread over northern Africa, and from there to Europe. In historical times the fate of armies has more than once been decided by disease rather than by battle, and it is quite probable that the defenceless Mecca was saved in this way, and that the story of the birds was afterwards invented for the edification of the faithful. One must remember, however, that in mediæval times the Christians of Europe were not loath to attribute one of the most pestilential of diseases to the malign influence of the followers of the Prophet.

That small-pox first visited the Western Empire about this time is borne out by the fact that the earliest known work on the disease was written by a physician of Alexandria, Ahron, who lived during the lifetime of the Prophet in the early part of the seventh century. No copy of this work is now known to exist, but extracts from it have been preserved for us in the writings of Rhazes.

We have, however, records of small-pox much earlier in both India and China. The Hindoo records indicate the existence of the disease in that country from very early times. There are names for the disease in the ancient Sanscrit, and the goddess of small-pox was worshipped under various names all over the country. Various names are given to this goddess, such as Mariatali and Patragali, and different explanations of her origin and power are given in the Hindoo mythologies. The treatment of patients affected with the disease was left to the goddess, who was invoked by prayers and

offerings, and to the Brahmins of her temple. These priests used a form of inoculation and a certain form of prayer, and the secret of their treatment was hereditary and closely kept. There is evidence that the disease was looked on with much dread, and the power of the goddess was greatly respected. There is a picture of one of the forms of this deity given as a frontispiece in James Moore's history of small-pox. The goddess, a huge figure, stands with a crooked dagger in each hand, uplifted and ready to strike on both sides. Before her stand a body of armed warriors ready to execute her vengeance. The two in the background wear red masks, carry black shields, and brandish naked scimitars. The lines radiating from the others are supposed to indicate the infection. Further off is a group of men with spotted bodies, waving black feathers, and with bells hung to their belts, carrying with them infection and death. The other group, carrying musical instruments, is supposed to be supplicating the mercy of the goddess, while the women behind her carry baskets of offerings on their heads as a thanksgiving for their lives and beauty saved. The small child taking something from the right arm of the goddess is supposed to be emblematic of inoculation.

Small-pox raged for many centuries in India, though in the sixteenth and seventeenth it was said to be so rare on parts of the coast that the Portuguese sailors were accused of introducing it into the country.

In China small-pox has been known from at least the third century B.C., and it was said to have been introduced into that country from Central Asia. Inoculation has been in use from 590 A.D., and is known as "sowing the small-pox," from the custom of introducing crusts from the small-pox pustules into the nose, and so infect-

ing the patient from a favourable case. The Chinese also worship a goddess of small-pox. There is a record of an epidemic of small-pox in Japan in the middle of the eighth century of our era, and Dr. Engelbert Kaempfer, physician to the Dutch Embassy in Japan, writing in 1690, states that both small-pox and measles were then diffused throughout the country.

In Thibet small-pox seems to have been present from very early times, and was greatly feared by the people. Captain Turner, Ambassador to the Tishoo Lama, writing in 1800, points out the very effectual way in which the people of that country dealt with outbreaks of the disease. When a case of small-pox was discovered the strictest isolation was enforced, the house and its inhabitants were shut up and all communication was cut off, even though this might entail the death of the people from starvation, and the house or village was afterwards destroyed. When small-pox broke out in the capital the Tishoo Lama left the place, and it was abandoned for three years without inhabitants till infection was considered to have died out. At the time of Captain Turner's visit it is stated that small-pox was seldom met with in Thibet, and when it did occur its progress was checked by the terror and vigilance of the inhabitants.

The evidence at our disposal would seem to suggest that Central Asia and possibly Central Africa were the original homes of small-pox, and that it has spread thence to the rest of the world. That it did not spread earlier need cause no surprise when we remember the great difficulty in communication between distant countries in those early days, and the time it took to get from one to the other. If infection did occur on board the ships of those early travellers it had ample time to die out before they reached home, and we can well believe

that there was little hesitation in abandoning a patient who was known to suffer from an infectious disease. It is certain at all events that there is no definite mention of the disease in the works of the Greek medical writers that have come down to us. It is possible, though unlikely, that the plague of Athens, described by Herodotus, was the small-pox, and most modern historians believe the disease to have been the true plague. Rhazes attributes a knowledge of the disease to Galen, but in this he was most probably wrong, and even he himself admits that if Galen did know the disease he has left us no information as to its treatment, a most unlikely state of affairs in the case of a voluminous writer such as Galen was. Paulus Ægineta, who is described as the last of the Greeks, and who wrote about 622 A.D., makes no mention of small-pox, though he states he "has left out no disease as far as possible." This is important evidence when we remember that Ahron, writing about the same time at Alexandria, states that the disease was fairly well known there at his time. Medical historians from the time of Freind have generally attributed the introduction of the disease, as well as our knowledge of it, to the Saracens. The first definite mention of the word "variola" occurs in the description of Marius, Bishop of Vaux, in Switzerland, who says that "in the year 570 a violent malady, with relaxations of the bowels and variola, affected Italy and France." It is questionable whether the variola here mentioned is the small-pox as we know it, for Gregory, of Tours, speaking with personal knowledge of this epidemic, uses words which appear to leave no doubt that plague was referred to. It is probable that small-pox did not become at all general, in Northern Europe at all events, till after the tenth century, and it is not unlikely that the spread of the disease

was in a great measure assisted by the crusades. In England and Ireland the early references to the disease are very vague. In the Anglo-Saxon Leech Book of Bald, written about the middle of the tenth century, there is reference to the "Pock," but that this refers to the small-pox is more than doubtful. The author says:—"Against the pocks a man shall freely employ blood-letting and drink melted butter, a bowl full of it: if they break out one must delve away each one of them with a thorn; and then let him drip wine or alder drink within them, then they will not be seen, or no trace will remain." Gilbert, one of the first of the English writers on Medicine, refers to small-pox, but he merely repeats the teaching of the Arabians. John of Gaddesden, who, in the early part of the fourteenth century, wrote the celebrated *Rosa Anglica*, repeats the description of small-pox that was given by the Arabian writers, but he is remarkable in that he states that he treated King Edward's son, the Prince, afterwards Edward II., for small-pox, and cured him by the use of red clothes, so that not a mark was left. This treatment was known in Japan from very early times. Holinshed, in his Chronicle, published in 1577, writing of the year 1366, states that "also manie died of the small-pox, both men, women, and children." It is probable, however, that this information is taken from an earlier chronicle in which the word "pokkes" is used, in a generic sense, for any skin lesion. Creighton, who has made very full investigations into the early history of small-pox in England, can find no mention of the disease in contemporary letters before the beginning of the sixteenth century. In 1514 it was stated that Henry VIII. had been ill of a disease which the physicians feared would turn to small-pox, but the King was recovered. There is among the Harleian manuscripts a letter dated

May 11, 1528, which states that some of the Royal Princesses are sick of the small-pox. It would seem probable that it was not till the end of the sixteenth or the beginning of the seventeenth century that small-pox became established in England.

Our information as to the time when small-pox was introduced into Ireland is also very conflicting. We have no definite information as to epidemics of the disease before the beginning of the eighteenth century, but Wilde states that it is referred to in the Irish MSS. from the beginning of the fifteenth. Dr. Rogers, when describing the epidemic of small-pox as it appeared in the South of Ireland at the beginning of the eighteenth century, says:—"This distemper, though of foreign growth and by transplantation brought amongst us, is now become a weed of our own soil and a native of our own country. It is well known that it came from Arabia, and that it can claim no longer a descent with us than about two centuries." "This," Wilde remarks, "well accords with the date of the first MSS. in which it is mentioned." Describing the epidemic of 1708 at Cork, Rogers says that it was "of the most crude and worst kind, that swept away multitudes."

From this view of the spread of small-pox let us now turn to consider the measures that were adopted to check its ravages and to cure the patients affected with it. In Thibet we have seen that a very strict isolation was enforced, and that the people of that country held the life of the individual as of little moment compared with the health of the community. In India and China it is probable that similar ideas prevailed to some extent, for we know how little value, even at the present time, is placed on the life of the individual in those countries. We have seen also how the help of the gods was sought

by prayers and offerings to check the disease, and how this help was supplemented by the treatment of the priests and by the practice of inoculation. It is probable also that considerable knowledge of the medical treatment of the disease existed in India in very early times, for Rhazes tells us of a certain syrup of pearls that the Indians use, of which they say that if anyone drinks of it "though nine pustules have already come out, there will not appear a tenth." The Greeks have left us nothing concerning the treatment of small-pox, probably because they were not acquainted with the disease, and our first definite medical pronouncement concerning treatment comes from the Arabian physicians. This treatment was purely personal, directed towards the cure of the individual, or the rendering of the individual less liable to attack, or better able to resist the disease should the attack come, and in no sense was it attempted to deal with the disease as it affects the community as does modern Preventive Medicine.

Rhazes, the first medical writer on small-pox whose works have come down to us, believed that fermentation and ebullition of the blood caused the disease, and as the blood of children tends much more to ebullition than the blood of old people, very few children escape small-pox, and old people rarely get it. As a preventive he recommends bleeding, cold bathing, and a strict regimen to keep the ebullition of the blood in check, and this, he says, "with God's permission, will have a good effect." In curative treatment he has much sound advice to give. He warns physicians to have great care lest they offend against nature, especially in depriving the body of its natural heat lest one does damage by "depressing the power which the natural heat has of resisting what is hostile to itself." He recommends great care to be taken

of the eyes to prevent blindness, and has many prescriptions both for this and for dealing with the pustules in their various stages. The followers of Rhazes for many hundreds of years advanced little on his teaching and methods. Avicenna (A.D. 992-1050) recommended that the pustules should be opened with golden needles, and this practice was still advocated in the sixteenth century. Averrhoes, a Spanish physician of the twelfth century, believed that the properties of substances depended greatly on their colour, and as "all red colours were hot from the fiery particles with which they manifestly abounded" red coloured things should be used about the patient to help in the maturation of the pock. Gilbert, an English physician of the reign of Edward I., further developed this idea by insisting that the patient should even have red coloured drinks, and we have seen that Gaddesden, his successor, boldly claimed that in this way he had cured the King's son. The important thing was that the patient should be kept hot in order to draw the pustules to the surface, and that he should be bled to remove as far as possible the evil from his body. The first great change in the treatment of small-pox patients was introduced by Thomas Sydenham, called the father of English medicine, who was born in the year 1624, and died in 1689. He was more cautious in the use of bleeding, and tried to make his patient comfortable. Thus we find him recommending cooling drinks and plenty of fresh air, while at the same time he banished the multitudes of red blankets. He gives a very accurate description of the disease, and looked on the discrete form as one "in no wise dangerous in itself." He goes on to say that "From these statements it is easy to answer the common question, as to why so many of the poor survive, and so many of the rich sink under an attack of small-pox; that

is, comparatively speaking. This can be referred to one cause only—viz., the want of opportunity on the part of the poor man for treating himself by a nice and delicate regimen. Their *res angusta domi*, as well as their more countrified manner of life, ensures this." Sydenham has nothing to say of preventive measures; he believed the disease to be the result of a "variolous constitution," and suggests its dependence on telluric and atmospheric conditions, over which we have no control. The practice of Sydenham, though bitterly opposed during his lifetime, gained great support afterwards, and continued to regulate English practice till recent years.

The first great change that was made in the treatment of small-pox in Western Europe after the time of Sydenham was the introduction, early in the eighteenth century, of inoculation. We have seen that there is reason to believe that this was practised both in China and India from early times. In India a particular sect of Brahmins travelled through the provinces and performed with much religious ceremony this operation. Persons about to be inoculated were advised to abstain from the use of both milk and butter for at least a month previously. Men were usually inoculated on the arms, and women low down on the shoulders. The skin of the part where the inoculation was to be made was first rubbed with a cloth, and often it was one of considerable value; this cloth afterwards became the property of the Brahmin. A few scratches were then made on the skin by some sharp instrument, and over these was bandaged a small pledget of wool that had been soaked in some variolous pus at least a year before. The wool was first moistened in some holy water from the Ganges, and during the operation the Brahmin repeated prayers from the Attharva Veda. In six hours the bandage was re

moved and the wool permitted to fall off of itself. Next morning cold water was poured on the head and shoulders of the patient, and this treatment was repeated every day till the fever appeared. The bathing was then interrupted till the eruption came out. When this appeared the bathing was begun again, and persisted in twice a day till the crusts fell off. When the pustules began to change colour they were opened by a sharp thorn. During the entire period of sickness the patient was to remain out of doors, though sometimes he was permitted to lie on a mat at the door of the house during the height of the fever. Cooling food and drinks were given during the illness, and the patient was directed to offer his prayers to the goddess for his recovery, while a present to the operator was expected as a thank offering to the goddess.

A similar practice came into use in other countries, though we have no information as to its origin. The operation was often performed by old women, and several punctures were made in different parts of the body. This was spoken of as "buying the small-pox," as the child to be inoculated was expected to bring the patient from whom the infection was taken a present of some dates or raisins as the price of the variolous matter. In certain parts of England and Scotland also this practice was in use among the poor people. Inoculation, however, as practised in Western Europe differed from that in India in that there was little care taken in the preparation of the patient, and recent infection was generally used. At the beginning of the eighteenth century inoculation was practised with great success in Constantinople, and in the year 1713 Dr. Emanuel Timoni, a Greek resident in that city, who had graduated in Oxford, wrote an account of the practice to Dr. Woodward, of England. This account was published in the "Philosophical Transactions

of the Royal Society of London” during the next year. In 1715 the Venetian Consul at Smyrna published in Venice an account of the Turkish practice. The accounts were corroborated by an English surgeon, Mr. Kennedy, who had travelled in Turkey. Mr. Kennedy published a paper on the subject in 1715, and in it speaks of “engrafting the small-pox.” These accounts did not attract any attention from the medical profession in England at the time. Dr. Timoni states in his paper that the practice had been in use in Constantinople for over forty years, and that he himself had personal experience of it for eight years, but he did not know of any patient who had died of the inoculated disease. It is due, however, to the action of Lady Mary Wortley Montague that the practice of inoculation was introduced into England.

In 1716 Lady Mary had accompanied her husband to Constantinople, where he had been appointed ambassador, and from that city many of her celebrated letters were written, giving an account of Turkish customs, and one of these, dated “Adrianople, April 1, O. S., 1718,” runs as follows:—“*Apropos* of distempers, I am going to tell you of a thing that will make you wish yourself here. The small-pox, so fatal, and so general amongst us, is here entirely harmless by the invention of *ingrafting*, which is the term they give it. There is a set of old women who make it their business to perform the operation every autumn, in the month of September, when the great heat is abated. People send to one another to know if any of their family has a mind to have small-pox: they make parties for this purpose, and when they are met (commonly fifteen or sixteen together), the old woman comes with a nut-shell full of the matter of the best sort of small-pox, and asks what vein you please to have opened. She immediately rips open that you offer to her

with a large needle (which gives you no more pain than a common scratch), and puts into the vein as much matter as can lye upon the head of her needle, and after that binds up the little wound with a hollow bit of shell; and in this manner opens four or five veins. The Grecians have commonly the superstition of opening one in the middle of the forehead, one in each arm, and one on the breast, to mark the sign of the cross; but this has a very ill effect, all these wounds leaving little scars, and is not done by those who are not superstitious, who choose to have them in the legs, or that part of the arm that is concealed. The children or young patients play together all the rest of the day, and are in perfect health to the eighth. Then the fever begins to seize them, and they keep their beds two days, very seldom three. They have rarely above twenty or thirty in their faces, which never mark; and in eight days' time they are as well as before their illness. Where they are wounded, there remain running sores during the distemper, which I don't doubt is a great relief to it. Every year thousands undergo this operation; and the French ambassador says pleasantly, that they take the small-pox here by way of diversion, as they take the waters in other countries. There is no example of any one that has died of it; and you may believe I am well satisfied of the safety of this experiment, since I intend to try it on my dear little son.

“ I am patriot enough to take pains to bring this useful invention into fashion in England; and I should not fail to write to some of our doctors very particularly about it, if I knew any one of them that I thought had virtue to destroy such a considerable branch of their revenue for the good of mankind. But that distemper is too beneficial to them not to expose to all their resentment the hardy wight that should undertake to put an end to it.

Perhaps, if I live to return, I may, however, have courage to war with them. Upon this occasion admire the heroism in the heart of your friend, &c."

Lady Mary was as good as her word. Writing to her husband, "Sunday, March 23, 1719," she says—"The boy was engrafted last Tuesday, and is at this time singing and playing, very impatient for his supper: I pray God my next may give as good an account of him. I cannot engraft the girl; for her nurse has not had the small-pox." This child, at that time three years of age, made a satisfactory recovery. On her return to England in 1722 Lady Mary decided to have her daughter, afterwards Lady Bute, inoculated, and sent for her surgeon, Mr. Maitland, who had attended her son at Constantinople, and desired him to perform the operation. Maitland tried to dissuade her, and suggested a consultation, but this was refused, and eventually Maitland inoculated the child. During the subsequent illness the child was watched by an old family apothecary and three physicians. It is stated that Lady Mary was so distrustful of these physicians that she never cared to leave the child when they were present. The inoculation was so satisfactory that Dr. Keith, one of the attending physicians, got Maitland to inoculate his own child. The report of these cases spread through the town, but the profession was greatly against the practice, and no more inoculations were done for some time. Caroline, Princess of Wales, who had already nearly lost one of her daughters by the small-pox, was most anxious to have the others inoculated. In order to test the method she obtained leave from George I. to have six condemned felons pardoned for the good of the public provided they would submit to inoculation. The felons were willing, but Maitland refused to inoculate them, fearing the

odium that would follow an unsatisfactory result. Sir Hans Sloan, then Court Physician, was appealed to in the difficulty, and when he, after consultation with a Dr. Terry, who had practised in Turkey, advised the trial of the experiment, Maitland consented, and inoculated six felons. Five of them contracted small-pox in a mild degree, the sixth escaped, but afterwards admitted having had small-pox in infancy. All six, however, escaped hanging. Orders were then given for the inoculation of the children on the charity of St. James' Parish, and this was done in the case of eleven of them, with a most successful result. The Princess was now satisfied, and determined to proceed with the inoculation of her own daughters. The King had a consultation with Sir Hans Sloan, and as a result of this granted his permission. The Serjeant-Surgeon inoculated the two children, and the resulting small-pox ran a most satisfactory course. The Royal example was followed to a considerable extent, but the profession and many of the clergy were greatly against it, and we are told that during the first eight years only 845 persons were inoculated, and of these 17 died. In other places the mortality was considerable, and such a clamour was raised against it that some States prohibited inoculation by law. People were told that if they died of natural small-pox it was an act of God, but if they died of inoculated small-pox they would be looked on as having committed suicide, and parents of those children who died after inoculation would be considered guilty of infanticide. The practice was said to be the invention of Satan and the offspring of atheism. In spite of many statistics published to show that the inoculated small-pox was much less fatal to the individual than the natural, inoculation made little headway. Thus Dr. Jurin stated "that of all the children that are born, there

will sometime or other die of small-pox one in fourteen," and "that of persons of all ages taken ill of the natural small-pox there will die of that distemper one in five or six," yet only one in sixty of the inoculated had died. In 1747 a small-pox hospital for the poor was started in London, and inoculation was practised there with satisfactory results. At first the inoculated patients were confined to the hospital till all danger of infection was passed, but later on all persons who applied at the gates were inoculated, and so allowed to carry the infection broadcast through the town. In 1752 some 3,538 persons died of small-pox in London alone. In the year 1754 the College of Physicians in London published a strong approbation of the practice of inoculation, and subsequently the medical opposition considerably declined.

For some time it was noticed that inoculation as practised by the medical profession was much more fatal than it was in the hands of monks and old women, and this gave the opportunity to Daniel Sutton, with whose name the practice of inoculation for the next few years was intimately associated. Daniel Sutton was the son of Robert Sutton, a surgeon at Debenham, and there for a time he and his brother assisted their father. Daniel then served as an Assistant Surgeon at Oxford, but returned to his father in 1763. He then proposed some modifications in the practice of inoculation which his father condemned as dangerous. This led to a disagreement between them, and Daniel settled for himself in Ingatestone, in Essex, where he set up as an inoculator, and claimed to be possessed of a secret that was infallible. By means of advertisements Sutton soon gained great notoriety, and it is said that he hired a clergyman to preach in his favour. This clergyman stated that Sutton and his assistants had inoculated over 2,000 persons with-

out fairly losing one. Many people sought the secret of his success, and it was his habit to communicate it to practitioners on condition of receiving a share of their profits. Finally, in old age, Sutton published his system, and it was found to contain nothing that was not previously known, but he had succeeded in taking from previous workers what was good and rejecting what was hurtful. He operated by a slight scratch, kept his patients cool, and purged them with calomel and antimony. Thomas Dimsdale was also a most successful inoculator in England at this time, and in 1766 he published an account of Sutton's method. In 1768 he was recommended to Catherine, Empress of Russia, and went to that country to teach the practice to the Russian physicians. He inoculated both the Empress and her son, as well as many of the nobility, and returned to England with the title of Baron and loaded with wealth.

In spite of inoculation and improved treatment, deaths from small-pox increased in numbers. It was calculated that at the beginning of the eighteenth century in London about one in fourteen of the inhabitants died of small-pox, but that during the last thirty years of the century the mortality increased to one in ten. At that time the annual loss of life in Great Britain and Ireland from small-pox was calculated at between thirty-four and thirty-six thousand persons.

The next great advance was marked by the publication in 1784 by Dr. Haygarth, of Chester, of "An Inquiry how to prevent the Small-pox." Haygarth's views were far in advance of his time, and had the real value of them been appreciated there can be little doubt that great benefit would have accrued to the nation. Haygarth took as his starting point the infectious nature of the disease, his words being "that at the present time it is

occasioned by neither climate, soil, nor season, but by infection only." He argued that mankind is not necessarily subject to the disease, and that one, though liable to it, will not take it unless exposed to infection. This infection comes from some person with the disease either directly or through clothing, or something soiled by the discharges or scabs from the infected patient. Although the infection may be carried through the air this is not usual, and it is probable that exposure to fresh air soon renders the poisonous matter inert. Haygarth had not at his disposal facts to prove at what time the variolous patient became infectious, but he shrewdly concluded that such persons were not infectious before the appearance of the eruption—that is, before the third day. He accepts the view that the infecting agent is of the nature of a ferment, "which by an admixture of a few of its particles with the blood occasions the generation of a large quantity of poison." In support of all these propositions he brings forward a number of facts derived from his experience of the epidemic in Chester in the years 1777-1778. In order to apply these theoretical conclusions to practice Haygarth drew up the following rules, and suggested that a reward should be offered to the poor for their observance, while the better classes should be asked to observe them "through motives of humanity, in order to preserve their fellow-creatures from so fatal a pestilence as the natural small-pox." The rules were as follow:—

"I. Suffer no person who has not had the small-pox to come into the infectious house. No visitor who has any communication with persons liable to the distemper should touch or sit down on anything infectious.

"II. No patient after the pocks have appeared must be suffered to go into the street, or other frequented place.

"III. The utmost attention to cleanliness is absolutely

necessary during and after the distemper. No person, clothes, food, furniture, dog, cat, money, medicines, or any other thing that is known or suspected to be daubed with matter, spittle, or other infectious discharges of the patient should go out of the house till they be washed, and till they have been sufficiently exposed to the fresh air. No foul linen, or anything else that can retain the poison, should be folded up and put into drawers, boxes, or be otherwise shut up from the air, but immediately thrown into water and kept there till washed. No attendants should touch what is to go into another family till their hands are washed. When a patient dies of the small-pox particular care should be taken that nothing infectious should be taken out of the house so as to do mischief.

“ IV. The patient must not be allowed to approach any person liable to the distemper till every scab is dropt off, till all the clothes, furniture, food, and all other things touched by the patient during the distemper, till the floor of the sick chamber, and till his hair, face, and hands have been carefully washed. After everything has been made perfectly clean, the doors, windows, drawers, boxes, and all other places that can retain infectious air should be kept open till it be cleared out of the house.” It was proposed to appoint inspectors, whose duty it would be to see that these regulations were carried out, and also to keep a register of all the cases of the disease with full particulars as to the persons and families infected. Haygarth did not propose to do away with inoculation altogether, but recommended that it should be done generally and at stated periods, say of two years, so that those who did not wish to be inoculated might keep away from those who were, and so escape infection. After Haygarth had elaborated his plan he found that one very

similar in scope and in design had for some time been most successfully adopted in Rhode Island. There small-pox patients were strictly isolated, and if the patient was so ill as not to be able to be moved with safety, the street was boarded up, the fact was advertised in the newspapers, and guards were set to prevent any one coming near the house. So great was the fear of the disease that these regulations, though at first sight irksome, were readily adopted by the people, so much so that it was said that they appeared "more like a popular custom than the restraints of the law." We nowadays can hardly realise the dread with which the deaths from small-pox had inspired the people at the end of the eighteenth century. Looking back after the lapse of years we can appreciate the advance made by Haygarth, and in how much he anticipated the most recent advances of modern sanitary science; but we can also see that his knowledge was insufficient to ensure for his plan more than partial success. The very success, too, which it would have achieved would have led to its ultimate failure. When freedom from epidemic small-pox during a number of years had dulled the fear that the people had of the disease, carelessness of the precautions would in an unprotected community have been followed by further epidemics. It was at this stage that Jenner came and offered a preventive measure against small-pox, which, in spite of the advances of the past century, still remains at once the most complete and most effective preventive measure of dealing with any infectious disease yet known to medical science.

Edward Jenner, a younger son of the Rev. Stephen Jenner, was born on May 17, 1749, at Berkeley, in Gloucestershire, where his father was vicar. The Jenner family had for some time been settled in

Gloucestershire, where the Rev. Stephen was possessed of some landed property. Edward received his early education at Dr. Washburn's Academy in Cirencester, and later became an apprentice to Mr. Daniel Ludlow, a surgeon at Sodbury, near Bristol. Having finished his apprenticeship, Edward went to London to "walk the hospitals," and there became a pupil of the great John Hunter, then one of the surgeons of St. George's Hospital. Jenner appears to have been a favourite pupil of Hunter, and several letters which passed between them at different times have been preserved. In 1772 Jenner returned to Berkeley, where he started in general practice as a physician, and as such seems to have been both successful and popular. He spent his leisure time in carrying out experiments in natural history, collecting material for his old master, John Hunter, and in writing verses. In 1788 a paper by him on the natural history of the cuckoo was read before the Royal Society, and in the following year he was elected a Fellow of that body. He married in 1788 a Miss Catherine Kingscote. In 1792 Jenner's practice had increased so much that he decided to confine himself entirely to medicine, and with that view obtained the degree of Doctor of Physic from St. Andrew's University.

For many years it had been recognised that a certain form of pustular disease of the udders of cows, known as cow-pox, was communicable to the hands of those that milked them, and it was popularly believed by dairy farmers that any one who had once contracted this disease from the cow was afterwards protected from attacks of small-pox either by natural infection or by inoculation. Indeed, in 1774, a farmer named Benjamin Jesty, of Yetminster, had designedly inoculated his wife and two sons with some of the matter taken from sores

on the udder of a cow the subject of cow-pox in order to protect them from an attack of small-pox. This inoculation produced rather severe constitutional symptoms that frightened Jesty at the time, but it was eminently successful, and the sons were found to be immune to inoculated small-pox thirty years afterwards. This tradition had been brought to the notice of Jenner while he was an apprentice at Sodbury, and had attracted him very much. He mentioned the matter to Hunter, and expressed the opinion that use might be made of this method to prevent small-pox. Hunter is said to have given him the advice "don't think, but try." While in practice at Berkeley, Jenner set himself to investigate this tradition and to accumulate facts which would either prove or disprove the validity of the claim set up. The investigation was not an easy one, and though he sought help both from the country people and from his medical friends he found the testimony most conflicting. He recognised, however, that there was more than one disease popularly described as cow-pox, and that there were analogous diseases in both horses and swine. As early as November, 1789, he inoculated his eldest son with swine-pox, and subsequently the child was on three occasions inoculated with variolous matter, but did not develop small-pox. Jenner did not make any secret of his investigations, and we have letters from more than one medical man dealing with the subject. Thus in 1794 Dr. Haygarth, of Chester, wrote to Jenner, giving him advice as to the conduct of his investigations. In May of 1796 cow-pox broke out in one of the dairies near Berkeley, and one of the milkmaids, Sara Nelmes, became infected in her hand. On May the 14th Jenner inoculated some of the matter from the vesicles on this girl's hand into the arm of a healthy boy, James Phipps,

aged eight years. Typical vaccinia followed this inoculation, and subsequent inoculation with variolous matter on two occasions showed that the boy was not susceptible to that disease. From this time till the spring of 1798 Jenner's experiments were interrupted by the disappearance of cow-pox from the neighbourhood. On the 16th of March, 1798, Jenner vaccinated William Summers on the arm with lymph taken from an infected cow. Summers went through an ordinary course of vaccinia, and lymph from him was transferred to one William Pead. Pead developed rather severe constitutional symptoms as a result, but there was no sign of any general eruption on the skin. From Pead several persons were vaccinated, including Jenner's own son, but in his case the vaccination was not successful. Several of these persons were subsequently inoculated with variolous pus, but not one of those so inoculated showed any sign of small-pox. These investigations Jenner now embodied in a paper which he wished to communicate to the Royal Society. This paper never formally came before the Society, but it was submitted unofficially to the President, and was returned to Jenner with the friendly admonition that as he had gained some reputation by his former work it would be unwise for him to present this lest it should injure his already established credit. Jenner was not satisfied with this decision, and in June of the same year he published in book form the paper entitled "An Inquiry into the Causes and Effects of the Variolæ Vaccinæ, a Disease discovered in some of the Western Counties of England, particularly Gloucestershire, and known by the name of Cow-pox." At the time of the publication of this book Jenner went to London, bringing with him a supply of vaccine lymph, and with some of this Mr. Cline, the celebrated surgeon of St.

Thomas's Hospital, vaccinated a child that was under his care in the hospital for disease of the hip. The vaccination was successful, and subsequent inoculation of the child with small-pox virus did not result in the development of that disease. The subject now attracted considerable attention, many experiments were made by different observers, and various papers both for and against the practice were published.

The practice of vaccination was not accepted without considerable opposition, and shortly after the publication of Jenner's book Dr. George Pearson, of London, published a long paper on the history of cow-pox, in which he stated that the disease was often associated with a general pustular eruption. In April of 1799 Jenner published "Further Considerations on the Variolæ Vaccinæ or Cow-pox," in which he maintained his previous position as regards the disease, and stated that he had not met with any cases of general pustular eruption such as Dr. Pearson had mentioned. Jenner suggested that the difference might be due to the fact that his patients were treated in the country, while the others were treated in the town. In May of the same year Dr. Woodville published a paper containing a record of some five hundred cases of vaccination for which the vaccine matter was derived from the cows in a dairy-yard in Gray's Inn Lane. Woodville pointed out that in three or four of his five hundred patients there were very serious symptoms as the result of the vaccination, and one of the children actually died. He concluded "if it be admitted that, at an average, one in five hundred will die of the inoculated cow-pox, I confess I should not be disposed to introduce this disease into the Inoculation Hospital, because out of the last five thousand cases of variolous inoculation the number of deaths has not exceeded the

proportion of one in six hundred." Pearson also recorded similar results, as did various other practitioners. Vaccination in most, if not in all, of these cases was performed with Woodville's lymph. Jenner replied to these strictures in a letter to the *Medical and Physical Journal*, and explained the cause of the trouble as due to the fact that variolous matter "had crept into the constitution with the vaccine." In July, 1800, Woodville replied with another pamphlet, in which he protested as to the purity of his vaccine, and stated that he had lately vaccinated two thousand persons without one alarming symptom. His former ill success he attributed to the vitiated atmosphere of the hospital. At this hospital patients affected with natural and inoculated small-pox were treated with the vaccinated persons. As a result of this controversy more care was taken in the collection of the lymph, and cases with a pustular eruption after vaccination became more scarce. Dr. Moseley, physician to Mr. Fox, was an active opponent of the practice; he published a paper in which he stated that "blindness, lameness, and deformity had been the result of employing the vaccine in innumerable instances." He also suggested that this communication with beasts might "corrupt the mind and excite incongruous passions" in those vaccinated. William Rowley was also a noisy, if not weighty, opponent of vaccination. On one occasion he introduced at his lectures a boy whose face was much swollen and disfigured by an abscess, and thus described the case:—"On this cheek you plainly perceive a protuberance arising like a sprouting horn; another corresponding one will shortly spring up on the other side; for the boy is gradually losing human lineaments and his countenance is transmuting into the visage of a cow." Mr. John Birch, Surgeon Extraordinary to the Prince of Wales,

was also a vigorous opponent, and after his death the following inscription was placed on his tombstone:—
“But the practice of Cow-poxing, which first became general in his day, undaunted by the overwhelming influence of power and prejudice, and the voice of nations, he uniformly and until death perseveringly opposed.”

That vaccination as performed in the early days of the last century, indiscriminately by all sorts of people and with all sorts of lymph, was sometimes fatal, or followed by serious septic conditions, we can well believe, and that too without any detriment to vaccination; but the occurrence of small-pox after successful vaccination was a real stumbling-block. Just as on the introduction of variolation small-pox was said never to follow it, so on the introduction of vaccination Jenner held that it was an absolute and permanent preventive. Cases, however, soon appeared in which small-pox did follow vaccination. At first such cases were explained by saying that the vaccination was unsatisfactory, or that a spurious cow-pox had been used. In the year 1811, however, the Hon. Robert Grosvenor, who had been vaccinated by Jenner himself ten years previously, was attacked with confluent small-pox. From this attack he recovered, but the case caused a great panic in London, and gave a new impetus to variolation. Statistics of large numbers of cases were then collected, and they showed that though small-pox might follow vaccination, yet it did so less frequently than it followed variolation, and as a rule the disease was of a mild form. In the year 1813 a report was published by the Imperial Institute of France, in which it was stated that of 2,671,662 persons properly vaccinated in France only seven afterwards had taken small-pox. In the Foundling Hospital of London vaccination was introduced in 1801, and though the children were sometimes

intentionally exposed to the infection of small-pox, yet in sixteen years only one slight case of that disease had occurred among them.

Early in May, 1800, vaccination was adopted in the army, and shortly afterwards in the navy, and in July of that year a declaration was signed by many of the chief medical men in London, expressing their confidence in the practice; this document had considerable influence in spreading vaccination. In 1802 Jenner petitioned Parliament for some remuneration as a reward for his discovery, and after an elaborate investigation by a committee £10,000 was voted him by Parliament. In 1806 the continued high rate of mortality from small-pox in London led Parliament to pass a resolution inviting the College of Physicians to consider the progress vaccination had made and the causes that retarded its general adoption. The College of Physicians, having consulted with the sister Colleges of Dublin and Edinburgh, presented a very full report to Parliament in July, 1807. On the receipt of this report the Chancellor of the Exchequer moved that a further grant of £10,000 be given to Jenner. An amendment proposing to increase the grant to £20,000 was eventually carried by a majority of thirteen.

Early in 1800 Dr. George Pearson established in London a Vaccine Pock Institution with the view of investigating the subject and of supplying the world with lymph. To this institution Pearson offered Jenner the position of extra corresponding physician, but as Jenner had not been consulted in the formation of the institution he declined the position. Pearson, at the head of this institution, was looked on as in opposition to Jenner, and in 1803 it was decided to start a Vaccine Society on different principles. The patronage of the Royal Family was obtained, and the Royal Jennerian Society was

started. Moore states that Pearson's Institution was "conducted on so mercenary a plan that it could be of little use." The Royal Jennerian Society, however, did not flourish. The first resident vaccinator appointed was a Quaker, Dr. Walker, who did not get on well with Jenner; religious differences soon occurred, and Dr. Walker was dismissed. A large number of Quaker followers of Dr. Walker left the Society with him and started another called the London Vaccine Institution. This caused a considerable falling off in the funds of the Royal Jennerian Society, and its downfall was completed by the appointment of a young Irish doctor, who appears to have had more aptitude for writing poetry than for vaccinating. A proposal was then made to Parliament to establish a National Vaccine Institute, and after a debate it was decided to do so. In 1808 the National Vaccine Establishment was started under the joint control of the Royal Colleges of Physicians and Surgeons with Jenner as director. In consequence, however, of some difference with the Board Jenner refused to act, and Dr. James Moore was appointed director in his place.

Vaccination was introduced into Dublin in March, 1800, and in 1804 the Cowpock Institution was established under the patronage of the Lord Lieutenant. This institution continues to work at the present time in Upper Sackville Street.

In India there was a good deal of trouble, as in that country the native inoculators made a considerable sum by variolous inoculation, and feared loss of income from the introduction of a practice which they said could not result in good, as no water from the Ganges was mixed with the lymph. The Government, however, offered to pay the native inoculators if they would prac-

tise vaccination instead of variolation, and soon the difficulty vanished.

In Ceylon small-pox committed great ravages, and it was estimated that one-sixth part of the population was killed by the disease. In 1800 the English started small-pox hospitals in which inoculation was practised, yet it was estimated that one in four of those who caught the disease naturally died, and one in thirty of those inoculated. In 1802 vaccination was introduced, the small-pox hospitals were closed, inoculation was forbidden, and in two years it is stated that the disease had disappeared from three of the principal districts of the island.

In 1803 a Spanish physician, Dr. Francisco Xavier Balmis, obtained a commission to propagate vaccination in the American and Asiatic Dominions of Spain, and for this purpose freighted a ship to trade at the ports he touched at. He was singularly successful both in vaccination and trading, so that in two years he succeeded in putting a vaccine girdle round the world and making a considerable fortune.

In January, 1823, Jenner died at Berkeley, having lived long enough to see the practice of vaccination adopted by almost every civilised country of the world, and having received honours and distinctions from many of them.

During the first quarter of the nineteenth century the practice of vaccination spread to a very considerable degree not only in the British Isles but also on the Continents of Europe and America. Thus in 1809-10 we find the State of Massachusetts passing statutes providing for vaccination and for the money to pay for it. In 1801 vaccination was introduced into Sweden, and in 1816 it was made compulsory in that country. In 1825 it was estimated that of the children born 70 per cent.

were vaccinated. In Denmark the practice of vaccination was introduced in 1801, and in 1810 it was made compulsory; from the records of that country it would seem that the law there was very satisfactorily carried out. In England there are no figures to enable one to arrive at a certain knowledge of the number vaccinated at that time; it is, however, probable that the number was considerable, and many of those who were not vaccinated had already had small-pox. In England legislation on the subject of vaccination was much later than in some of the countries of the Continent. In 1802 and 1806 Parliament had made money grants to Jenner as already mentioned, and for some time annual grants were also made to the National Vaccine Establishment. In July, 1840, was passed "An Act to extend the Practice of Vaccination" (3 & 4 Vic., cap. 29). This Act applied to England and Wales, and by a special section was extended to Ireland. It empowered the guardians and overseers of every parish to contract with their medical officers to vaccinate such persons as might apply to them. Payments were to be made to these officers, such payments to depend on the number of persons successfully vaccinated for the first time. By this Act the practice of inoculation was made illegal. In June of the following year, 1841, an Act was passed providing that the expenses for carrying out the Act of the previous year should be charged on the poor rates, but persons vaccinated under the Act were not to be considered as in receipt of parochial relief, and were not to be deprived of any privilege in consequence. In August, 1853, at the instigation of the Epidemiological Society, "An Act to extend and make Compulsory the practice of Vaccination" was passed, but was made to apply only to England and Wales. By this Act children were to be vacci-

nated within three months of birth under a penalty of twenty shillings, and the payment to public vaccinators was regulated. In 1861 a further Act was passed to empower guardians to appoint persons to prosecute offenders under the former Act, and to make parents perpetually liable during the period of default. "The Public Health Act, 1858," was one of considerable importance, as it vested in the Privy Council certain powers for the protection of the public health. The Privy Council was now given powers to issue regulations as to the qualifications of public vaccinators, and generally to control the practice. These powers the Privy Council continued to exercise till they were transferred to the Local Government Board by the "Local Government Board Act, 1871." In 1867 a consolidating statute was passed (30 & 31 Vic., cap. 184), which also introduced some new provisions. The payments to public vaccinators were increased, and the Privy Council was empowered to pay Public Vaccinators additional sums as a reward for successful work. Payment for revaccination was also enforced, and parents were compelled to bring their children to the vaccinator a week after the operation and to permit him to take lymph from them if he wished to do so. This Act was further amended by Acts passed in 1871 and in 1874, but the changes were chiefly of an administrative nature.

In Ireland the legislation has been somewhat different from what it was in England. The Acts of 1840 and 1841 had applied to Ireland as well as to England, but the compulsory Act of 1853 did not apply to Ireland. In 1863 an Act was passed making vaccination compulsory in Ireland (26 & 27 Vic., cap. 52). The children were to be vaccinated within six calendar months of birth, and for the operation a fee of one shilling was to be paid to the

medical officer. The parents were to bring the children to the medical officer for inspection on the eighth day after the operation. In 1868 a short Act (31 & 32 Vic., cap. 87) was passed making inoculation with variolous matter a penal offence, and providing that persons vaccinated by the public vaccinator should not be considered as in receipt of poor law relief. In 1878 a section dealing with vaccination was introduced into the Public Health (Ireland) Act similar to section 31 of the English Act of 1867. In 1879 the last Act dealing with vaccination in Ireland was passed. This Act reduced the time within which a child might be vaccinated from six to three months. It raised the fee for the operator from one to two shillings, and permitted the vaccinator to take, if he wished, lymph from the vaccinated child.

(The Vaccination Acts in force in Ireland are:—21 & 22 Vic., cap. 64; 26 & 27 Vic., cap. 52; 31 & 32 Vic., cap. 87; 42 & 43 Vic., cap. 70. Except sections 1, 2, 3 and 13 of 26 & 27 Vic., cap. 52, which were repealed by section 13 of 42 & 43 Vic., cap. 70).

In Scotland the Vaccination law is practically comprised in one statute that was passed in 1863 (26 & 27 Vic., cap. 108). This Act made vaccination compulsory in Scotland. In that country it would seem that the majority of the people vaccinated are under the care of private practitioners, and the public vaccinators deal only with paupers and the children of paupers, except in the case of defaulters, who must either be vaccinated by the public vaccinator or submit to the penalties of the law. Vaccination in Scotland, too, differs from that in the other parts of the British Isles in that the public vaccinator vaccinates chiefly in the person's own house and not at a dispensary.

In Germany vaccination was early introduced, but for

some time the practice was purely voluntary. In 1834 vaccination was made compulsory for every recruit joining the Prussian army, whether he had been vaccinated before or not. In 1874 compulsion was extended to the civil population. According to this law of April, 1874, every child must be vaccinated before the end of the calendar year following the year of birth, and all school children must be revaccinated in their twelfth year. Obedience to this law is enforced by fine or imprisonment. In Austria there is no compulsory vaccination, though since 1891 vaccination has been "promoted" by the sanitary authorities. Vaccination, though very largely carried out, is not compulsory in France. In Paris when information is received of the occurrence of small-pox in any district vaccinators are sent to the district in question, and they make domiciliary visits for the purpose of offering vaccination to those persons who are unable or unwilling to attend the public vaccination stations. In such cases the vaccination is performed directly from the calf to the arm of the person, and for that purpose the calf is sent to the house from the Institut Vaccinal in a specially constructed van.

The experience gained in the past hundred years of vaccination in different countries has not been unproductive in both our knowledge and practice of the method. When vaccination was introduced by Jenner it was a more or less isolated method of preventive treatment—a substitute for variolous inoculation. Jenner believed that vaccinia was variola so modified by passing through the cow that though it preserved its preventive properties, it had lost its infective properties, and as it had been recognised that one attack of small-pox gave a practical immunity from future attacks of the disease, so he claimed for vaccinia that

it gave practically a perpetual immunity also. The cases in which this immunity failed, when not attributable to inefficient vaccination, he looked on as similar to those exceptional cases in which more than one attack of small-pox occurred. Experience has shown that this position cannot altogether be maintained; primary vaccination confers a certain amount of immunity against small-pox, which immunity, however, lessens as time goes on, and it would seem that the immunity resulting from primary vaccination in infancy is neither so great or so lasting as that resulting from adult vaccination. This decrease in immunity can, however, be renewed by re-vaccination, which should always be done in case of vaccination in infancy, and is advisable even when the primary vaccination took place during adult life. It has also been recognised that the immunity acquired as the result of vaccination and revaccination varies in different individuals. In some it is greater, in others it is less. We are not yet in a position to state the factors on which this difference depends, though it seems probable that it bears some causal relation with the number and extent of the marks resulting from the vaccination. In the time of Jenner this immunity resulting from vaccination was a more or less isolated phenomenon, but recent investigations have given us many parallel examples. In many diseases, the result of infection by micro-organisms, it has been shown that infection by the parasite has resulted in the formation in the body fluids of substances which are antagonistic to the growth of the micro-organism, and not only can the presence of these substances be demonstrated, but their efficiency can also, to a certain extent, be measured. This knowledge has been made use of to a large extent in medical treatment, and the use of these immunising substances, artificially produced, has

been one of the triumphs of modern medicine. Though there is good ground to believe that small-pox is a disease due to the infection of the body by a parasitic micro-organism, and it is probable that this organism has been identified, demonstrative proof of this is not yet forthcoming, and till this proof has been obtained it is not possible to demonstrate the absolute identity of variola and vaccinia, but short of demonstrative proof there seems to be little room for doubt in the matter.

In the practical application of vaccination the advance has been even greater than the advance in our theoretical knowledge. In the early days of vaccination the accidental inoculation of extraneous micro-organisms with the vaccine matter was often the cause of serious results to the vaccinated person. Indeed, the wonder is that this was not always the case; but since aseptic methods have been introduced this accident is both rare and preventable, just as is infection of a wound after a surgical operation. Formerly arm to arm vaccination, or the use of human lymph, was the general rule, and there was always the possibility of the lymph having been taken from a diseased person and so of inoculating the vaccinated person with some other disease as well as with the vaccinia. Now, calf lymph is almost universally employed, and the animal from which the lymph is taken is submitted to a very thorough investigation to show that it is not the subject of any disease before the lymph is inoculated into human beings. Lymph, however, collected under the most favourable conditions is always liable to contamination with extraneous organisms, and its subsequent sterilisation, without destroying its efficacy, was a matter of great difficulty. During the past twenty years this difficulty has been overcome, and now it is possible to remove from the lymph the ex-

traneous organisms without interfering with its activity. This has been effected by the use of glycerine. The fresh lymph is thoroughly mixed with glycerine in a special machine; it is then sealed up in sterile tubes and stored in a dark place for from four to six weeks, after which time it is found to be free from extraneous organisms. At first glycerine was used merely to dilute the lymph and to increase its bulk, for as far back as 1868 Müller had shown that this did not impair the efficacy of the vaccine. The fact that the addition of glycerine was of actual benefit was later pointed out by different workers. The Italians claim that Leoni made this discovery in 1888, his work being published in 1890. The Germans claim priority for Schulz, of Berlin, and state that the method of glycerinating lymph for this purpose has been in use in Germany since 1888. In England the work of Copeman has been of great value. His communication was made to the International Congress of Hygiene in 1891, when he fully demonstrated the value of this process. St. Yves Ménard and Chambon, of Paris, have also done good work in this connection. Much earlier than any of these workers Koch, in 1883, had recognised that extraneous micro-organisms gradually disappeared from lymph to which glycerine had been added, but he does not seem to have recognised the importance of the observations from the vaccinator's point of view. The lymph prepared in this way is carefully examined by bacteriologists before it is issued to the public, and its issue is not permitted unless its purity is beyond suspicion. In these countries every medical student before he becomes a registered practitioner is compelled to take out a special course in vaccination. The rules in connection with this course seem to many to be unduly stringent, but they ensure that every medical prac-

titioner has been instructed in what is believed to be the best and safest way of performing vaccination.

It would not be right to close this review of the history of the prevention of small-pox without paying some tribute to the benefits that have been derived from modern methods of sanitation. The good work that has been done in the past fifty years has borne fruit in the prevention of small-pox epidemics as in the case of the other zymotic diseases. Dealing with small-pox, however, by such methods is of peculiar difficulty. The human race, even when living under the most satisfactory sanitary conditions, appears to be particularly susceptible to the disease, and experience has shown us that very few unprotected persons escape the disease entirely, if they are exposed to infection. Further, the infection seems to be readily carried by the air, and the striking distance seems to be greater than with most other diseases. These difficulties have led to the adoption in many places of special regulations for the prevention of small-pox. In Germany such special regulations do not exist, and small-pox is dealt with under regulations quite similar to those in force for the prevention of other diseases, reliance being placed on the protection afforded to the community by vaccination and revaccination. In England the matter is different, and the following regulations have been issued by the Local Government Board. "Hospitals for small-pox.—In view of the frequently demonstrated liability of small-pox hospitals to disseminate that disease to neighbouring communities, and in order to lessen the risk of such occurrence, the Board require the following conditions to be complied with in the case of small-pox hospitals provided by means of loans sanctioned by them:—1st. The site must not have within a quarter of a mile of it either a hospital, whether

for infectious diseases or not, or a workhouse, asylum, or any similar establishment, or a population of as many as 200 persons. 2nd. The site must not have within half a mile of it a population of as many as 600 persons, whether in one or more institutions, or in dwelling-houses. 3rd. Even where the above conditions are fulfilled, a hospital must not be used at one and the same time for the reception of cases of small-pox and of any other class of disease." In dealing with individual cases of small-pox most health authorities insist on the immediate removal of the patient to an isolation hospital, and at the same time on the isolation of all persons who have recently been in contact with the patient. Sometimes this isolation of contacts is effected by their removal to special places, but in other cases it is considered better to isolate them in their own homes. Whichever course is adopted it is attended with considerable expense. That this expenditure is of benefit, however, is evident from the results which were obtained at Leicester during the epidemic of 1892-1893, and in the last epidemic in Dublin. The efficacy of sanitary measures in preventing the spread of small-pox is also well shown by the case of Australia. Up to 1838 Australia had enjoyed an absolute immunity from small-pox; towards the end of that year the disease appeared in Sydney, but lasted only a short time. It then remained absent from the Continent till 1868, when it was introduced into Melbourne, but was quickly stamped out. In New South Wales, by an Act passed in 1882, notification of small-pox was made compulsory on medical men and householders under heavy penalties. At Sydney notification of small-pox is followed by the compulsory removal of the patient, and all persons who have been in the house with the patient, to the quarantine station at North Head. This station is

670 acres in extent, and situated on the peninsula at the mouth of Sydney Harbour. It is seven miles from the Health Office, with which there is telephonic and telegraphic communication. The persons are conveyed to the station by a steamboat, comfortably fitted expressly for the purpose, and no difficulty has been experienced in effecting the removal. The persons who have been in the house with the patient are detained twenty-one days in quarantine from the date of the last possible contagion. Should a case of small-pox arise among them, those who had been in contact with such infected person would be detained for a further period of twenty-one days, and so on. To facilitate this the exposed persons are distributed in separate groups within the station. They are allowed to receive letters or parcels, and a telegraph operator is employed whose special business is to work the telegraph at their request. Reasonable compensation is given by the Government for loss, and there are heavy penalties whereby the quarantine is secured. Dr. MacLaurin, the President of the New South Wales Board of Health, said that the station is "a pleasant place to stay in, and everything is done that can be done to make the people comfortable; they have nothing whatever to do, and are free from all care, and they can spend the day pleasantly enough; but they do not like it." No one, however, raises any objection to the Sydney system, and "the people are all very sensible about it." In New South Wales there is very little vaccination, and there is no compulsory vaccination law. In all Australian towns a similar system is carried out just as strictly, and on February 5th, 1890, there was not a case of small-pox in all Australia.

There seems to be a tendency in the preventive treatment of small-pox to return to the ancient methods of

Thibet of strict isolation, carried out perhaps with more humanity and with more regard for the interests of the individual than was the case in that country, but still on a similar principle. Where these methods are thoroughly carried out they will probably be found quite efficient, and be beneficial not only in the prevention of small-pox but also in the promotion of the general health of the community. The experience, however, of sanitary workers in these countries does not justify the assumption that they are applicable as yet in their completeness to the conditions of our country. In spite of the great advances in sanitation during the last fifty years it has not been found possible to control the incidence of other zymotic diseases to a similar extent as we have been able to control that of small-pox, though many of these appear to be more amenable to control by sanitary measures than is small-pox. The difference, we believe, is due to the preventive action of vaccination and re-vaccination. We must consequently add our tribute to that of the nations of the world to the illustrious Jenner for his great discovery—a discovery the benefit of which has been and is enormous. Whether Jenner's method will continue to be necessary or not in the future for the prevention of small-pox will depend on whether the great mass of the people will or will not be prepared to submit to the restrictions on their so-called liberty which are entailed by a rigid observance of sanitary laws.

SIR JOHN MOORE thought the failure of the present system of dealing with small-pox in the United Kingdom was in the lack of re-vaccination. The example of Germany was an example for the world. Taught by the lesson of the pandemic of 1870-71, the Parliament of the German Empire passed a compulsory vaccination

law in 1874, in accordance with which every child must be vaccinated before reaching the age of one year, and re-vaccinated before twelve years. The result of the system had been shown by the slides. In Germany the hospital treatment of small-pox presented no difficulty: there was no fuel to catch fire when a spark alighted in the centre of one of the German cities. Far different would it be even in well-vaccinated Ireland. Primary vaccination in infancy conferred an absolute immunity for the time being; but whether it was owing to the rapid growth of the body and the multiplication of unprotected cells, that immunity was transitory, and the necessity arose for re-vaccination at an age approaching puberty, when anabolism and katabolism were more nearly balanced. Re-vaccination, he ventured to think, in most cases established a life-long immunity. It was with dismay that one marked the terrible craze of anti-vaccination that was creeping into Ireland. It was a serious matter that in the south-eastern part of Leinster there should be a decided rebellion against vaccination. Dr. Kirkpatrick could render no more valuable service to the country than to take his slides down to Enniscorthy and invite the people to go and see them.

DR. DONNELLY said the Section, and indeed the whole country, owed a great debt of gratitude to Dr. Kirkpatrick. He believed that the present outburst of anti-vaccination was largely due to the fact that nowadays even medical men in Ireland did not see small-pox at all; it was taken for granted that it would not come. At present there are many false statements spread abroad by papers, such as the *Vaccination Enquirer*. About 10 per cent. were unvaccinated, and when the spark came in 1895 small-pox spread among those who were unvaccinated, and also among those who were not re-vaccinated. At the time, certain persons in the hospital to which he was attached refused to be re-vaccinated, and got an attack, but those who were re-vaccinated did not. When the epidemic came there was no trouble in getting the people generally to be re-vaccinated, and the result was that the small-pox was stamped out in a little over a year. Something strong ought to be done to counteract the wave of anti-vaccination, and one of the best things would be to educate the people by having such lectures as we have just listened to delivered in various centres throughout the country.

DR. E. J. M'WEENEY agreed with the suggestions as to the education of the people. The mere showing of Dr. Kirkpatrick's slides demonstrating the ghastly thing that confluent small-pox was, and the marvellous effects of re-vaccination in the German Empire, would carry conviction to every mind. It was one of the great difficulties of the present Governmental system that it was not possible to bring in any highly competent outsiders and utilise them for purposes so intimately affecting the public weal. The Local Government Board was keen on having the anti-vaccination delusion stamped out, but its hands were tied, and it could employ only its own officials. He was responsible for the bacteriological purity of the lymph which was issued to vaccinators in Ireland, and he could testify that it was produced with the utmost cleanliness and asepticity. Vaccine lymph had a very distinct bacteriological flora, which consisted of organisms found in the skin of the calf. When taken directly from the skin some had a certain pyogenic power, like the staphylococci found in the human skin; but after subjection to the action of glycerine they seemed to lose that power. The method of vaccinating direct from the calf to the arm had been found to give too vigorous a local reaction: the micro-organisms had not been attenuated, and the method was very properly not practised in Ireland. He thought Dr. Kirkpatrick might have referred to the services of Dr. Copeman in advocating the glycerination of lymph as a means of getting rid of the organisms or of their power of producing suppuration. It was an astonishing thing to learn that the infectious nature of small-pox was not recognised until 1780.

DR. KIRKPATRICK, in reply, said that although he had not actually mentioned Dr. Copeman's name, it was recognised that modern methods of preparing lymph were practically entirely due to his work, which he had in mind when describing the process.