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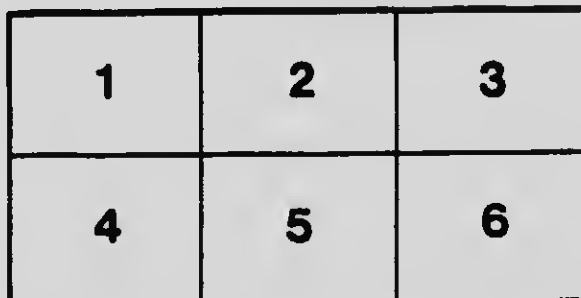
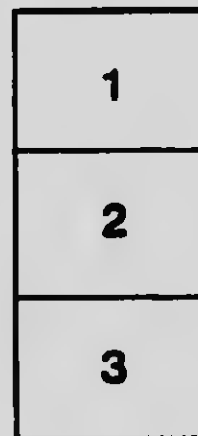
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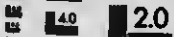
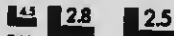
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EDWARD JENNER AND VACCINATION

BY PROFESSOR D. FRASER HARRIS, M.D., D.Sc.

Reprinted from THE SCIENTIFIC MONTHLY, October, 1915

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EDWARD JENNER AND VACCINATION

BY PROFESSOR D. FRASER HARRIS, M.D., D.Sc.

DALHOUSIE UNIVERSITY, HALIFAX, N. S.

WE are so exceedingly apt to take our blessings as a matter of course that at the present time a large number of us have quite forgotten, and some of us have never known, what a terrible disease smallpox is and from how much suffering national vaccination has saved us. But even many of us, who may not be included amongst those who know nothing of smallpox, do come within the group of those who know next to nothing of the life and work of Dr. Edward Jenner. A number of persons think he was Sir William Jenner, physician to Queen Victoria.

An infectious or communicable disease is one caused by the admission of some form of living matter into the body of a human being or of a lower animal. All diseases are clearly not communicable in the sense that they are due to the presence of living things. Indigestion, for instance, I can not communicate to my neighbor, however serious my dietetic indiscretions.

Now, while the actual microorganisms causing many of the infectious diseases have been discovered in these recent days through the agency of the microscope—one of science's most valuable gifts to suffering humanity—a few diseases undoubtedly infectious have, even up to the present time, not had their microorganic causes discovered. Smallpox or variola is one of these. The term variola is from the Latin *varus*, a pimple.

The name Small Pox, which first occurs in Holinshead's "Chronicle" (1571), was given to this disease to distinguish it from the Great Pox or syphilis, the French disease, or *Morbus Gallicus* which attained the proportions of an epidemic in Europe about 1494. The expression "The Pox" in the older medical literature always refers to the *Lues Venerea*. The word "pox" is the plural form of pock; the spelling "pox" is phonetic; "pocks" is the correct form.¹

Smallpox is unquestionably a highly infectious or communicable disease, and, in the language of a past day, there is a virus or poison which can pass from the sick to the unaffected; when this transference occurs on a large scale we speak of an epidemic of smallpox. As Sir William Osler truly says, "It is not a little remarkable that in a dis-

¹ Thus the following expression in Galt's "Annals of the Parish" is justified—"My son Gilbert was seized with the smallpox and was blinded by them for seventeen days."

case, which is rightly regarded as the type of all infectious maladies, the specific virus still remains unknown." The same, however, is true of the common diseases of scarlatina, measles and chickenpox. Of some diseases, the virus is a bacillus or coccus, excessively minute fungi recognizable only under the microscope; but the bacteriologists are now beginning to speak of viruses so impalpable that they, unlike ordinary bacteria, can go through the pores of a clay filter, are filter-passers, that is are of ultra-microscopic dimensions. Some authorities conjecture that the virus of variola belongs to the group of filter-passers. The virus of smallpox, however, is very resistant and can be carried through the air for considerable distances; it clings for long periods to clothes, books, furniture, etc.

I shall not now digress to give the clinical details of a case of smallpox; the eruption may be slight or it may be very extensive. It occurs in three forms, discrete, confluent and hemorrhagic. The most dangerous form of smallpox is the confluent, in which the face and arms particularly are covered with large pustular areas of a most disfiguring appearance.

The disease called chickenpox, or varicella, has no relationship to smallpox and does not protect from it, nor does smallpox protect from chickenpox.

HISTORY OF SMALLPOX

There seems very little doubt that the home of smallpox was somewhere on the continent of Africa, although it is true that there are traditions pointing to its existence in Hindustan at least 1000 B.C. One Hindu account alludes to an ointment for removing the cicatrices of eruption. Africa has certainly for long been a prolific source of it: every time a fresh batch of slaves was brought over to the United States of America there was a fresh outbreak of smallpox.² It seems that the first outbreak in Europe in the Christian era was in the latter half of the sixth century, when it traveled from Arabia, visiting Egypt on the way. The earliest definite statements about it come from Arabia and are contained in an Arabic manuscript now in the University of Leyden, which refers to the years A.D. 570 and 571. There is a good deal of evidence that the Arabs introduced smallpox into Egypt at the sacking of Alexandria in A.D. 640. Pilgrims and merchants distributed it throughout Syria and Palestine and along the north of Africa; then, crossing the Mediterranean, they took it over to Italy. The Moors introduced it into Spain whence, *via* Portugal, Navarre, Languedoc and Guienne it was carried into western and northern Europe. The earliest physician to describe smallpox is Ahrun, a Christian Egyptian, who wrote in Greek. He lived in Alexandria from A.D. 610 to 641. The first

² Osler thinks the *pesta magna* of Galea was smallpox; Marcus Aurelius died of it.

independent treatise on the disease was by the famous Arabian physician, Rhazes, who wrote in Syriac in 920 A.D., but his book has been translated into both Greek and Latin. The first allusion to smallpox in English is in an Anglo-Saxon manuscript of the early part of the tenth century; the passage is interesting—"Against pockes: very much shall one let blood and drink a bowl full of melted butter; if they [pustules] strike out, one should dig each with a thorn and then drop one-year alder drink in, then they will not be seen," this was evidently to prevent the pitting dreaded even at so early a date. Smallpox was first described in Germany in 1493, and appeared in Sweden first in 1578.

The contributions of Sydenham, the English Hippocrates, to the knowledge of smallpox, are classical.

Throughout the Middle Ages, owing to the very crowded and unsanitary state of the cities of Europe, smallpox was one of the various plagues from which the inhabitants were never free for any length of time.² Leprosy, influenza, smallpox, cholera, typhus fever and bubonic plague constituted the dreadful group. In most countries, including England, smallpox was practically endemic; an attack of it was accepted as a thing inevitable, in children even more inevitable than whooping-cough, measles, mumps or chickenpox is regarded at the present time. There was a common saying—"Few escape love or smallpox." In the eighteenth century so many faces were pitted from severe smallpox that it is said any woman who had no smallpox marks was straightway accounted beautiful. Very few persons escaped it in either the mild or the severe form in childhood or in later life.

Now it is characteristic of a microorganic disease that a person who has recovered from an attack of it is immune from that disease for a longer or shorter time, in some cases for the remainder of life. This is, luckily, as true of smallpox as of any of the other acute infections. We do not now need to enquire into the theory of how this comes about; it is a well-recognized natural phenomenon. The modern explanation is in terms of antigens and anti-bodies and is fast passing from the stage of pure biochemical hypothesis into that of concrete realization. Persons who have recovered from smallpox rarely take it a second time; the few who do, have it in a mild form. It follows, then, that if smallpox is purposely inoculated into a human being he will for a long time be resistant to the subsequent infection of smallpox. The fact of smallpox protecting from smallpox is by no means without analogy in other diseases. Thus in Switzerland, in Africa, in Senegambia, it has been the custom for a long time, in order to protect the cattle from pleuro-

² England was by no means exempt, but it was not infection in the modern sense that Shakespeare meant when he wrote—

"This England,
This fortress, built by Nature for herself
Against infection and the hand of war."

pneumonia, to inoculate them with the fluid from the lung of an animal recently dead of pleuro-pneumonia. Of course since the time of Pasteur we have been quite familiar with the inoculation of attenuated virus to protect from the natural diseases in their fully virulent form, for instance, anthrax, rabies, plague and typhoid fever.

As it was, then, known to mankind from a very early period that a person could be protected from smallpox by being inoculated with it, inoculation grew up as a practise in widely distant parts of the globe. The purpose of intentional inoculation was to go through a mild attack of the disease in order to acquire protection from the much more serious natural form of the disease—to have had it so as not to have it. A very high antiquity is claimed for this smallpox inoculation, some even asserting that the earliest known Hindu physician (Dhanwantari) supposed to have lived about 1500 B.C., was the first to practise it. Bruce in his "Voyages to the Sources of the Nile" (1790) tells us that he found Nubian and Arabian women inoculating their children against smallpox, and that the custom had been observed from time immemorial. Records of it indeed are found all over the world; in Ashantee, amongst the Arabs of North Africa, in Tripoli, Tunis and Algeria, in Senegal, in China, in Persia, in Thibet, in Bengal, in Siam, in Tartary and in Turkey. In Siam the method of inoculation is very curious; material from a dried pustule is blown up into the nostrils; but in most other parts of the world the inoculation is by the ordinary method of superficial incision or what is called scarification. By the latter part of the seventeenth century inoculation for smallpox was an established practise also in several European countries into which it had traveled by the coasts of the Bosphorus, *via* Constantinople. In 1701 a medical man, Timoni, described the process as he saw it in Constantinople. Material was taken from the pustules of a case on the twelfth or thirteenth day of the illness. As early as 1673 the practise was a common one in Denmark, Bartholinus tells us. In France inoculation had been widely practised; on June 18, 1774, the young king Louis XVI., was inoculated for smallpox, and the fashionable ladies of the day wore in their hair a miniature rising sun and olive tree entwined by a serpent supporting a club, the "pont à l'inoculation" of Mademoiselle Rose Bertin, the court milliner to Marie Antoinette. In Germany inoculation was in vogue all through the seventeenth century, as also in Holland, Switzerland, Italy and Circassia. In England the well-known Dr. Mead, honored, by the way, with a grave in Westminster Abbey, was a firm believer in inoculation, as was also Dr. Dimsdale, who was sent for by the Empress Catherine II. to introduce it into Russia. Dr. Dimsdale inoculated a number of persons in Petrograd, and finally the Grand Duke and the Empress herself. The lymph he took from the arm of a child ill of natural smallpox. For his services to the Russian

court Dr. Dimsdale was made a Baron of the Russian Empire, a councillor of state and physician to the Empress. He was presented with the sum of £1,000 and voted an annuity of £500 a year. At the request of Catherine, Dr. Dimsdale went to Moscow, where thousands were clamoring for inoculation. The mortality from smallpox in Russia seems to have been still higher than in the rest of Europe. The annual average death rate on the Continent at the end of the eighteenth century was 210 per 1,000 deaths from all causes, while in Russia in one year two million persons perished from smallpox alone. In England in 1796, the deaths from smallpox were 18.5 per cent. of deaths from all causes.

A great impetus was given to inoculation in England by the letters of Lady Mary Wortley Montague, the wife of our ambassador to Turkey, Edward Wortley Montague, and daughter of the Duke of Kingston. In 1717 Lady Mary wrote a letter to her friend Miss Chiswell, in which she explained the process and promised to introduce it to the notice of the English physicians. So convinced was Lady Mary of the safety of smallpox inoculation and its efficacy in preserving from subsequent smallpox, that in March, 1717, she had her little boy inoculated at the English embassy by an old Greek woman in the presence of Dr. Maitland, surgeon to the embassy. In 1722 some criminals under sentence of death in Newgate were offered a full pardon if they would undergo inoculation. Six men agreed to this, and none of them suffered at all severely from the inoculated smallpox. Towards the close of the same year two children of the Princess of Wales were successfully inoculated; and in 1746 an Inoculation Hospital was actually opened in London, but not without much opposition. As early as 1721 the Rev. Cotton Mather, of Boston (U. S. A.), introduced inoculation to the notice of the American physicians, and in 1722 Dr. Boylston, of Brooklyn, inoculated 247 persons, of whom about 2 per cent. died of the acquired smallpox as compared with 14 per cent. of deaths amongst 6,000 uninoculated persons who caught the natural smallpox. There was, however, great popular opposition to the practise of inoculation, and Dr. Boylston on one occasion was nearly lynched.

While successful inoculation undoubtedly protected the person from smallpox, sometimes the inoculated form of the disease was virulent, and certainly all cases of inoculated variola were as infectious as the natural variety. Inoculated persons were therefore a danger to the community; and there is no doubt that such persons had occasionally introduced smallpox into towns which had been free from the natural disease. At the end of the eighteenth century, just about the time of Jenner's discovery, public opinion was strongly against the continuance of the practise of inoculation, and as natural smallpox had not at all abated its epidemic character, the times were ripe for "some new thing."

Now there is a disease of cows known as cowpox or vaccinia (from the Latin *vacca*, a cow) which is communicable to human beings. It is thought to be due to the same virus which in pigs is called swinepox and in horses "grease." Jenner believed vaccinia to be the same pathological entity as human smallpox, modified, however, by its transmission through the cow. For a long time this view was stoutly resisted, but it has now been accepted as probably representing the truth. The identity of vaccinia and "grease" is certainly much more doubtful.

To many of Jenner's contemporaries the view that vaccinia had at one time been a disease of human beings seemed unlikely; but we are now in a far better position to admit its probability than were those of Jenner's time. We have since then learned that man shares many diseases with the lower animals, tuberculosis, plague, rabies, diphtheria and pleuro-pneumonia, to mention only a few. We have also learned that certain lower animals, insects for instance, are intermediary hosts in the life-cycle of many minute parasites which cause serious diseases in the human being, amongst which malaria, yellow fever and the sleeping sickness are the most familiar.

It appears to have been understood before Jenner's time that persons who had acquired cowpox by handling cattle, but especially by milking cows, were immune from smallpox. In the reign of Charles II. it is well known that the court beauties envied the dairy-maids because having had cowpox, they could not take smallpox which all women so dreaded. Dr. Corlett tells us that the Duchess of Cleveland, one of the King's mistresses, on being told that she might lose her place in the royal favor if she were disfigured by smallpox, replied that she had nothing to fear as she had had cowpox. In 1769 a German, Böse, wrote on the subject of cowpox protecting from smallpox. In the year 1774 a cattle dealer, Benjamin Jesty, at Yetminster, in Dorset, inoculated his wife and three children with cowpox. None of them ever took smallpox during the rest of their lives although frequently exposed to its infection. Jesty died in 1816, and it is recorded on his tombstone that he was the first person who inoculated cowpox to protect from smallpox. Cowpox, or vaccinia, though infectious for cows, is not transmissible among human beings, in other words, as a disease of man it is not infectious. Edward Jenner, the Englishman of Berkeley in Gloucestershire, was the first person to think scientifically on the fact that cowpox protected from smallpox. John Hunter had said to him, "Jenner, don't think, try." Luckily, however, he did both. Thinking alone avails little, experimentation alone avails not much, but the one along with the other has removed mountains. Just as Newton thought scientifically about that falling apple and reduced our conceptions of the universe to order, just as Watt thought scientifically about that kettle-lid lifted by the steam and so introduced the modern era of

mechanical power brought under man's control, so Jenner thought about and experimented with cowpox until he had satisfied himself that he had discovered something which would rid the human race forever of the incubus of an intolerable pestilence.

It was in 1780 that Jenner set himself to study cowpox in a way that had never before been attempted, for he was convinced that in the having had an attack of the disease lay the secret of the conquest of that world-scurge. He confided in his friend Edward Gardner about "a most important matter . . . which I firmly believe will prove of essential benefit to the human race . . . should anything untoward turn up in my experiments, I should be made, particularly by my medical brethren, the subject of ridicule." Luckily he was quite prepared for both ridicule and opposition; for has not everything new been ridiculed and opposed? Galileo was opposed, Bruno was opposed, Copernicus was opposed, Harvey was opposed, George Stevenson was opposed, Pasteur was ridiculed and opposed, and so were Darwin, Simpson and even Lister. The physiological inertia even of the educated has too often blocked the path of advancement: but Jenner is in illustrious company, a prince amongst the hierarchy of the misunderstood.

The facts or surmises before Jenner at this date, then, were—
(a) Cowpox produces an eruption extremely like that of mild smallpox, it is, therefore, probably a form of smallpox modified by transmission through the cow; (b) And an attack of cowpox protects from smallpox. To test these things experimentally some one must first be inoculated with cowpox, and, having recovered from the vaccinia, that same person must, secondly, be inoculated with the virus of smallpox or be exposed to the infection, and, thirdly, this person ought not to take the disease.

In 1788 Jenner had a careful drawing made of the hand of a milkmaid suffering from cowpox to demonstrate to Sir Everard Home how exceedingly similar were vaccinia and variola. Home agreed it was "interesting and curious," and the subject began to attract some attention in medical circles.

In November, 1789, Dr. Jenner inoculated his eldest child Edward, aged 18 months, with some swinepox virus, and as nothing untoward happened, he inoculated him again with swinepox on April 7, 1791. The child had a slight illness, very like vaccinia, from which he rapidly recovered. The moment for the crucial experiment was not yet; it came in due time, but Jenner had to wait five years for it, and five years are a long time to a man who is yearning to perform his crucial experiment. Happily for suffering humanity, in the early summer of 1796 the opportunity came; the hour and the man were there together.

Cowpox had broken out on a farm near Berkeley and a dairy maid called Sarah Neames contracted the disease. On May 14, 1796, Dr. Jenner took some fluid from a sore on this woman's hand and inoculated

it by slight scratching into the arm of a healthy boy eight years old, by name James Phipps. The boy had the usual "reaction" or attack of vaccinia, a disorder indistinguishable from the mildest form of smallpox. After an interval of six weeks, on July 1, Jenner made the most momentous but justifiable experiment, for he inoculated James Phipps with smallpox by lymph taken from a sore on a case of gennine, well-marked, human smallpox, *and the boy did not take the disease at all.* Jenner waited till the nineteenth of the month, and finding that the boy had still not developed variola, he could hardly write for joy. "Listen," he wrote to Gardner, "to the most delightful part of my story. The boy has since been inoculated for the smallpox which, *as I ventured to predict*, produced no effect. I shall now pursue my experiments with redoubled ardor."

Here we are behind the scenes at a great discovery; "as I ventured to predict"; prediction is part of scientific theorizing; there is a place for legitimate prediction as there is for experimentation. All discoverers have made predictions; Harvey predicted the existence of the capillaries, Halley predicted the return of his comet, Adams predicted the place of the planet Neptune, the missing link in the evolutionary series of the fossil horses had been predicted long before it was actually found by Professor Marsh. Pasteur predicted that the sheep inoculated with the weak anthrax virus would be alive in the anthrax-infected field, while those not so protected would all be dead. A prediction verified is a conclusion corroborated, an investigator encouraged.

Early in 1797, through another outbreak of cowpox, Jenner was able to inoculate three persons with variola, only to find as before that they were immune from smallpox. He now felt himself justified in preparing a paper for the Royal Society, the highest scientific tribunal in England. The council, however, returned him his paper with the remark that in their opinion the amount of evidence was not strong enough to warrant its publication in the *Transactions*. Jenner was wise enough not to be discouraged, and so in June, 1798, he published the paper himself under the title, "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 cowpox." This historic pamphlet, which ranks with the great classics of medicine, was dedicated to Dr. C. H. Parry, of Bath. Later on the Royal Society was sagacious enough to elect the very man whose paper it had previously refused.

While in London attending to the publication of his pamphlet, Dr. Jenner called on the great surgeon Mr. Cline, and left some cowpox virus with him for trial. Cline inoculated a young tubercular patient with vaccinia and later with smallpox in no less than three places. In due time this patient did not show a sign of smallpox. So impressed

was Cline with this remarkable result that he wrote to Jenner thus: "I think the substitution of cowpox poison for smallpox one of the greatest improvements that has ever been made in medicine. The more I think on the subject, the more I am impressed with its importance."

The word "vaccination" was coined by the French, so remarkable for the aptness of their descriptive terms, and it has ever since remained with us as a convenient expression for the inoculation of vaccinia as protecting from variola.⁴

Dr. Jenner's views were now becoming known, and the critics and the doubters had appeared: St. Thomas has always had a large following. The most formidable of the early objectors was Dr. Igenhouz, who had come to London to study inoculation for variola, and had already inoculated, among other notable persons, the Archduchess Theresa Elizabeth of Vienna. The careless vaccinations of Doctors Pearson and Woodville at the London Smallpox Hospital brought much apparent discredit on Jenner's work. In all his early work Jenner used lymph obtained directly from papules on the cow or calf, but Woodville in 1799 showed that excellent results could be got from arm-to-arm vaccination. As this latter method is a very convenient one, the technique was widely adopted. We have to remember that we are speaking of a period about sixty years before Lister gave to suffering humanity that other great gift, antiseptis: and so many arms "went wrong," not because of being vaccinated, but because the scratches were afterwards infected by the microorganisms of dirt. Jenner knew well the difference between the reaction of clean vaccination and that of an infected arm, but a great many medical men of his time did not, and so he was constantly plagued with reports of vaccinations "going wrong" when it was septic infection of uncleansed skin that had occurred. The explanation of these things by letter consumed a very great deal of his valuable time. By the end of 1799 a large number of persons had, however, been successfully vaccinated. As one Pearson proved troublesome by starting an institution for public vaccination on principles which Jenner knew to be wrong, and as Jenner found himself virtually supplanted and misrepresented, he came up to London in 1800 to vindicate his position. The King, the Queen and the Prince of Wales, to whom he was presented, materially helped on the cause by countenancing the practise of vaccination. Lord Berkeley, his Lord of the Manor, was in this as in all things a kind and wise

⁴ It is certainly not necessary to point out that the principle of vaccination has been one of wide application in modern medicine. Our word "vaccine" testifies to this. A vaccine is a liquid, the result of bacterial growth, injected into a patient in order to render him immune from that particular disease which is caused by sufficient infection with the microorganisms in question, *e. g.*, of typhoid fever or of plague.

patron. In the United States of America vaccination made rapid progress, having been introduced there under the good auspices of Dr. Waterhouse, professor of medicine at Cambridge, Mass. The discovery was announced with true American informality as "Something curious in the medical line," on March 12, 1799.

Things went even better on the continent of Europe; deCarro, of Vienna, inaugurated vaccination with such zeal and discrimination that it spread to Switzerland, France, Italy and Spain. From Spain it passed over to Latin America. In Sicily and Naples, "the blessed vaccine" was received by religious processions. Sacco, of Milan, commenced vaccinating in 1801, and in a few years had vaccinated 20,000. In Paris, a Vaccinc Institute was established; and Napoleon ordered all his soldiers who had not had smallpox to be vaccinated. On Jenner's application, the Emperor liberated several English prisoners remarking—"What that man asks is not to be refused." Napoleon voted 100,000 francs for the propagation of vaccination. Lord Elgin introduced it into Turkey and Greece. The Empress of Russia, Catherine II., was one of the greatest supporters of Jennerian vaccination. She decreed that the first child vaccinated in Russia should be called "Vaccinoff," should be conveyed to Petrograd in an imperial coach, educated at the expense of the state and receive a pension for life. The Emperor of Austria and the King of Spain released English prisoners at Jenner's request. There were statues of Jenner erected abroad, at Boulogne and at Brünn, in Moravia, before any in England. Thus the European countries showed their gratitude to the Englishman whose patience, genius and absence of self-seeking had rid them of the detestable world-plague of smallpox. Vaccination was made compulsory by law in no less than five European countries before it was so in the United Kingdom in 1853. In eight countries vaccination is provided free at the expense of the government. The clergy of Geneva and of Holland from their pulpits recommended their people to be vaccinated. In Germany, Jenner's birthday (May 17) was celebrated as a holiday. Within six years, Jenner's gift to humanity had been accepted with that readiness with which the drowning clutch at straws. The most diverse climes, races, tongues and religions were united in blessing vaccination and its discoverer. The North American Indians forwarded to Dr. Jenner a quaintly worded address full of the deepest gratitude for what he had saved them from: "We shall not fail," said these simple people, "to teach our children to speak the name of Jenner, and to thank the Great Spirit for bestowing upon him so much wisdom and so much benevolence."

There are two allusions to smallpox in "Don Juan," which was published in 1819, showing to what an extent Jennerian teachings were in the air. The first is:

The doctor paid off an old pox
By borrowiog a new ooe from an ox.
(Canto I., stanza 129.)

The second is :

I said the smallpox has gooe out of late,
Perhaps it may be followed by the great.
(Stanza 130.)

Before 1812, Jenner had been made an honorary member of nearly every scientific society in Europe, and had received the freedom of the cities of London, Edinburgh, Dublin and Glasgow. The Medical Society of London presented him with a gold medal struck in his honor; in Berlin in 1812 there was a Jennerian festival on the anniversary of Phipps's vaccination. Addresses and diplomas were showered on him, and in 1813 the University of Oxford conferred on him the degree of M.D. honoris causa. As he refused point blank to pass the examination in Latin and Greek required by the Royal College of Physicians of London, Jenner never obtained admission into that learned body. When some one recommended him to revise his classics so that he might become an F.R.C.P. he replied, "I would not do it for a diadem"; and then, thinking of a far better reward, added: "I would not do it for John Hunter's museum."

But while the pure in heart were thus receiving the blessing offered them by the benovolent man of science, the pests of society, those discontented and jaundiced ones who are always to be found in the dark recesses of the cave of Adullam, were not idle. Many of his medical colleagues did indeed sneer, as some are always apt to do at any new thing however good. To all these Jenner replied, and a very great deal of his valuable time was consumed in arguing with them. But the sect of the anti-vaccinators had arisen, and was to some extent organized. Caricatures, lampoons, scurrilities, vulgarities and misrepresentations, the mean, were scattered on all sides. Nothing was too absurd to be stated or believed—that vaccinated persons had their faces grow like oxen, that they coughed like cows, bellowed like bulls and became hairy on the body. One omniscient objector declared that, "vaccination was the most degrading relapse of philosophy that had ever disgraced the civilized world." A Dr. Rowley, evidently imagining himself honored by a special participation in the Divine counsels, declared that "small-pox is a visitation from God, but cowpox is produced by presumptuous man. The former was what Heaven had ordained, the latter is a daring violation of our holy religion." It was rather hard to blame Dr. Jenner for the origin of cowpox. It took much forbearance to endure this sort of thing; but Jenner's was a first-class mind and he evidently dealt leniently even with fools. It was not for the first time in the world's history that a lover of mankind had been spurned with the words—"He hath a devil and is mad."

Besides enduring all these mental and physical worries, and the annoyance that the Royal Jennerian Society established in 1802 was so mismanaged that it collapsed in 1808, Jenner had spent a very large sum of private money on the introduction of vaccination. He had been, as he himself expressed it, "Vaccine clerk to the whole world." Parliament, it is true, in 1801, voted him a sum of £10,000 which was not paid for three years afterwards and was diminished by £1,000 deducted for fees, so that it barely recompensed him for his outlays. By 1806, the immensity of the benefit conferred upon his diseased fellow-creatures having been recognized more perfectly in every other country than his own, the British Parliament woke up, and voted him a sum of £20,000, only one member representing the anti-vaccinators opposing the grant. Parliament, which had previously received from the Colleges of Physicians of London, Edinburgh and Dublin the most favorable reports of the efficacy of vaccination, decided to reestablish the Royal Jennerian Institute. A subscription of £7,383 from grateful India reached Jenner in 1812. In 1814 he was in London for the last time, when he was presented to the Emperor of Russia, Alexander I., who told him that he had very nearly subdued smallpox throughout that vast Empire. Jenner refused a Russian order on the ground that he was not a man of independent means.

The management of the Institute caused him much concern in his later years; he disapproved of the personnel and of many of the details of its working. One of the last worries of his life was an article in the November number for 1822 of the famous *Edinburgh Review*. Although it contained a good deal of praise, it was not favorable to Jenner, who said of it, "I put it down at 100,000 deaths at least." I have ascertained that this article was not written by the celebrated Francis Jeffrey, although he was editor of the *Review* until 1829.

Jenner's life, apart from his great discovery and his developing the practice of vaccination, has not much incident in it. He was born on May 17, 1749, the son of the Rev. Stephen Jenner, vicar of Berkeley, Gloucestershire, England, the same Berkeley in whose castle, Edward II., the vanquished at Banockburn, was murdered in 1327. Jenner's mother's name was Head. Edward went to school at Wotton-under-Edge and at Cirencester, and began to study medicine with a Mr. Ludlow, a surgeon at Sodbury near Bristol. In his twenty-first year, Jenner went to London as a pupil of the great John Hunter, in whose house he lived two years, during which time he was entered as a medical student at St. George's Hospital. It is interesting to know that while still a student he was asked by Sir Joseph Banks to arrange and catalogue the zoological specimens brought home by the circumnavigator Captain Cook in his first voyage of 1771. Jenner devoted considerable attention to natural history, to geology and to the study of fossils, on which topics

he kept up correspondence with Hunter long after he left London. In the year 1788 he married a Miss Kingscote, and settled down to practise in his native place. Mrs. Jenner died in 1815, after which date Jenner never left Berkeley again.

Curiously enough, it was not until 1792 that Jenner obtained the degree of M.D., and it was not from an English university at all, but from the University of St. Andrews in Scotland. This university, the smallest although the oldest of the Scottish universities, has therefore the honor of being the Alma Mater to the epoch-making Englishman. I have seen the entry of the name in the list of graduates for the year 1792; it has evidently been misspelled, for the name is corrected. The first foreign university to recognize Jenner's eminence was Göttingen. In 1794 Jenner had an attack of typhus fever. Jenner never cared for London or a city life, and although in 1808 he was persuaded to take a house in town, he soon gave it up and went back to his beautiful Gloucestershire. For many years he practised during the season in the pleasant health-resort of Cheltenham. He loved the country, he studied lovingly the living things around him there: many are familiar with a piece of verse he wrote on "The signs of rain."

The year 1810 was a sad one for Jenner: his eldest son died, and that noticeably depressed his health. In 1823 he presented a paper to the Royal Society on the migration of birds, a subject not even yet fully cleared up. On January 25, in the same year, he was stricken with paralysis on the right side and died within twenty-four hours. His body was buried in the chancel of the parish church of Berkeley, where there is a memorial window placed by public subscription. In person, Edward Jenner was short and rather heavily built; his expression of face was pleasant with a touch of sadness. All reports agree that in dress he was conspicuously neat, looking more like a gentleman-farmer than a physician, with his blue coat, yellow buttons, red waistcoat, buff breeches and top-boots.⁵

There is no disguising the fact that during his lifetime Dr. Jenner was much more appreciated in foreign countries than in England. The medico-social club of Alverton, near where he lived, would not listen to him when he addressed them on vaccination. The effort to collect enough money from the medical men of England in order to place a marble statue to Jenner in the nave of Gloucester Cathedral, was successful only after a long delay. An attempt to erect a statue in London died of apathy; but in 1858, 32 years after he died, a statue was erected in Trafalgar Square. In 1862 it was removed to a quiet corner of Kensington gardens; and perhaps its surroundings, the trees, the flowers and the birds he loved are more suitable than the effigies of those national heroes who served their country by taking, not by saving life.

⁵ He was painted by Sir Thomas Lawrence, by Northcote and by Vigneron.

No, Nelson the hero is hardly the suitable companion for Jenner the hero.

There is no doubt that Jenner's medical contemporaries, at least in England, failed to appreciate the magnitude of the gift their colleague had presented not merely to his own country, but to the world at large. The discovery had, of course, been led up to by several different lines of indication, but this in no way detracts from the genius of Jenner in drawing his memorable inductions from the few facts which others had known before his time. The fame of Newton is no whit diminished because Copernicus, Kepler and Galileo lived and worked before him, the credit due to Harvey is none the less because many before his time had worked on the problem of the heart and vessels, and because some of them, notably Cesalpinus, came within a very little of the discovery of the circulation; the achievements of Darwin are not to be belittled because Lamarck, Malthus or Monboddo had notions in accordance with the tenor of his great generalization of evolution among living beings. Certainly Jenner had precursors; but it was his genius and his genius alone which, putting together the various fragments of knowledge already possessed, gave us the grand but simple induction based on his own experiments that vaccinia prevents from variola. It was too simple and too new to be appreciated in all its bearings either by the medical men or the laity of his own day. Its impressiveness is not inherent in it, as it is in the mathematical demonstration of universal gravitation, as it is in the atomic theory or in that of the survival of the fittest through natural selection. The English country doctor merely said in essence—"let me give you cowpox and you will not get smallpox." Unless the fact of this immunity is regarded as possessed by all the nations of the world for ever more there is nothing particularly impressive in it; and so it failed to impress his contemporaries. It is only when we contrast the loathsomeness and danger of smallpox with the mildness and safety of vaccinia and varioloid that we grasp the greatness of the work which Jenner did for mankind. The very simplicity of vaccination detracts from its impressiveness unless its results are viewed through the vista of the centuries. We need the proper historical perspective in this as in all else. Thus viewed, however, the simplicity of the procedure and the universality of its application are most imposing. Vaccination does not, indeed, dazzle the scientific imagination like some of the other generalizations of biology, but it is one that has been gloriously vindicated by the subsequent history of the world's hygiene.

Jenner knew himself to be a benefactor of the human race; he would have been insincere if he had pretended otherwise; he finished his first paper with these words: "I shall endeavor still farther to prosecute this enquiry, an enquiry, I trust, not merely speculative, but of

sufficient moment to inspire the pleasing hope of its becoming essentially useful to mankind"; and on his death-bed he said, "I do not marvel that men are not grateful to me, but I am surprised that they do not feel grateful to God for making me a medium of good."

In private life Dr. Jenner was amiable and kind-hearted. Diben said of him: "I never knew a man of simpler mind or of warmer heart." He was particularly kind to the poor. Dr. Matthew Baillie said of him: "Jenner might have been immensely rich if he had not published his discovery."

We may in conclusion examine some of the objections to and criticisms of vaccination. The objections can be classified as those entertained (a) by medical men and (b) those by the public generally.

The objections raised by medical men are now a matter of ancient history. Each generation of medical men has refused at first to admit any new teaching promulgated in its time; physiological inertia is not at once overcome. The most enlightened of Jenner's critics *did really* believe that he was drawing too extensive an induction from insufficient data; this was the position of the Royal Society in 1788; but the Edinburgh reviewer of 1822 should have known better. The purely technical criticisms of Jenner's work have by this time been fully assessed and replied to. It is true that at one time it was not clear what were the relationships of chickenpox and smallpox, of vaccinia and variola, of vaccinia and varioloid, of the various forms of pox in animals—cowpox, swinepox, horsepox or grease—either *inter se* or to human smallpox. But I do not suppose that in this year of grace 1914 there can be found one properly trained medical man, acquainted with the history of Jennerian vaccination, familiar with the ravages of smallpox and with the protective power of vaccinia, who could be induced, by no matter how large a bribe, to say that he disapproved of vaccination or that he believed it did not protect from smallpox. There are cranks in all walks of life, but the medical crank who is also an anti-vaccinationist is happily the rarest of them all.

The lay objectors—the professed anti-vaccinators—are with us yet in spite of some very serious lessons which have been taught them. We may pass by the objectors of the class who believe that vaccinated persons cough like cows and bellow like bulls; these objections go into the limbo of old wives' fables or into the category of wilful misrepresentation. Unfortunately there is a large class of persons who can believe the absurdest nonsense about any subject which is particularly distasteful to them.⁶ Another class of objection is the sentimental repugnance to the idea of being given one of the diseases of "the lower

⁶ Anti-vaccinators constantly allude to calf-lymph as "filth"; if lymph is filth, then I am able to assure them that each one of them has about three liters of it in his own body.

animals." Now the fact is that already we share a great many diseases with the lower animals, a few of them being tuberculosis, anthrax, rabies, tetanus, cancer, pleuro-pneumonia, certain insect-borne diseases, some parasitic worm diseases and some skin diseases like favus. As the knowledge of the lowly origin of many of our diseases is more widespread, this sort of objection will die out.

An objection which is worthy of more consideration is that in being vaccinated a child is apt to contract some infectious disease such as tuberculosis or syphilis which are the two most dreaded. Now so long as arm-to-arm vaccination was the routine practice, there was a remote probability that this sort of accident might occur. It appears to be true that a few accidents of this kind have occurred, just as a few arms have become septic or had erysipelas develop in them. But when the few such cases are compared with the millions and millions of uncomplicated vaccinations, their importance becomes very insignificant. Now that arm-to-arm vaccination is no longer practised, but fresh calf-lymph used for each child, these accidental inoculations are a thing of the past. The ignorance of cause and effect is responsible for a great deal of the most childish objections to vaccination as to much else. One woman lately told me that she could not have her child vaccinated because a child in the same street was made a cripple for life by being vaccinated. Could we have a better example of the "post hoc sed non propter hoc."?

Now and again, however, we have the sad spectacle of some one really well educated but apparently either ignorant of logic or desirous of wilfully misrepresenting facts. The Hon. Stephen Coleridge has an article in the June (1914) number of the *Contemporary Review* which is, to say the least of it, highly immoral in ethics and statistics.

I shall examine only that part of it bearing on vaccination. The statements are that in the last five recorded years, 58 persons died from smallpox vaccination (he means vaccination against smallpox), whereas in the same five years, 85 persons died from smallpox itself. The inference we are intended to draw from these figures is that to be vaccinated is nearly as fatal as to have smallpox itself.

Now this kind of argument is a very common one with statistically immoral persons, and is known as the suppression of the ratio. Before we can appreciate the fact that in five years 58 persons died after being vaccinated, we at least need to know the total number of persons who were vaccinated. If only 58 persons were vaccinated and they all died, then the mortality was 100 per cent., but if, as was practically the case, thousands of infants in Great Britain were vaccinated in five years, then if only 58 died after vaccination (although not necessarily in consequence of it) the mortality falls some thousands of a per cent. The suppression of the ratio, i. e., 58/many thousands is the deceit that is practised.

Fifty-eight per year for five years, is 11.6 deaths per year of persons vaccinated: presumably these were infants: taking the birth-rate in England as 30 per 1,000 living, we may say that 900,000 infants were born; deduct 100,000 as not vaccinated, we have 800,000 infants vaccinated, of these 11.6 died after

There is still that group of persons who object to everything—anti-vivisection, anti-meat eating, anti-breakfast, anti-hats and of course also anti-vaccination. They are anti the usual and the normal that are quite good enough for the most of people. They generally also believe that the earth is flat; they are pest praying for, all we can do with them is to look them, like the difficulty of Jonah and the whale, "full in the face and pass on."

Many people at the present time allow themselves to be persuaded into being anti-vaccinators because neither they nor their deluders have ever known what an epidemic of smallpox is, have never seen with their own eyes the awful spectacle of a person suffering from smallpox in any

being vaccinated, which is 0.0014 per cent. This is not much of a mortality from any cause; but using Mr. Coleridge's own figures, it is a splendid demonstration of the safety of infant-vaccination, the opposite of what he pretends it shows.

Mr. Coleridge proceeds to tell us that in five years 85 persons died of smallpox in Great Britain, *i. e.*, an average of 17 persons per year. In other words 17 persons died of smallpox in a country with 30 million inhabitants, or 0.000050 per cent. of persons living, not a high mortality. And we strongly suspect, may we hope, that those 17 were persons who had not been vaccinated.

But in Pre-Jennerian days, 17 persons died of smallpox out of every 100 persons dying from all causes.

Mr. Coleridge's figures, properly and honestly interpreted, testify loudly to conclusions exactly the opposite of what he desires to insinuate; he has no doubt taken the statistics of the Registrar-General, but he has prostituted them.

Mr. Coleridge's paper could not be a better example of the art of concealing the causes of phenomena.

He exhibits the following table:

Deaths from smallpox per annum per a million living:

1862-1870	172.2
1871-1880	244.6
1881-1890	45.8
1891-1900	13.3
1901-1910	12.8

So that the table shows that since 1880 in Great Britain the deaths from smallpox per million per year have declined until they are only about 1/14th of their original number.

The natural inference from these figures, viewed in the light of the history of smallpox in Great Britain, is that compulsory vaccination has been steadily eradicating the disease; but this is not Mr. Coleridge's conclusion: He says it is due to the large number of persons who have refused to be vaccinated! This would be laughable if it were not really serious; it is sad and serious that a man of Mr. Coleridge's education and social position should so consistently mislead the uncritical readers of the *Contemporary Review* to whose page he has unfortunately very free access. If Mr. Coleridge really believes these things he is either very stupid or very ignorant; if he knows them to be otherwise, but willfully deceives the public, he is immoral. He suffers from the worst form of bias, the anti-scientific.

of its forms—discrete, confluent or hemorrhagic. Thanks to this very Jenner, the world has now for 100 years been almost free from epidemic, virulent smallpox and most perfectly so in the vaccinated countries, so that millions, the majority, of Englishmen, have never seen a case of smallpox at all. Not knowing the awful danger they have escaped, through Great Britain having had compulsory vaccination since 1853, they have become lax in their belief in the necessity for the continuance of that precaution. "They jest at scars that never felt a wound." Towns such as Gloucester in England, in which a large number of children have been allowed to grow up unvaccinated, have always been visited sooner or later by a serious outbreak of smallpox. It must be so; the laws of natural phenomena can not be changed to suit the taste of those persons who are mentally incapable of understanding them. They can not be evaded; ignorance of the law is no more an excuse in the realm of natural than of man-made law.

We now come to that undesirable product of present-day, grandmotherly legislation, the conscientious objector. As I am not a politician, I shall not say anything for or against the policy of inserting in a bill which makes vaccination compulsory a clause giving to the conscientious objector the power or right to refuse to have his child vaccinated, but as a medical man who knows a little of the history of medicine, I can only describe it as gratuitous folly. I am one of those who believe that the laity should have no say in the matter of whether any given procedure is or is not advantageous for the public health. The efficacy of universal inoculation of vaccinia as a prophylactic against variola is a question of scientific medicine to be decided on technical grounds and ought not to be a matter open to debate by the public at all. It is perfectly monstrous to suppose that the ordinary person, quite untrained to weigh evidence for or against the advisability of the carrying out of a particular form of national immunization against a horrid disease, is qualified to form any opinion. He might as well be consulted on the advisability of making the channel tunnel or on the safest type of aeroplane or on any other subject involving the technical training of the engineer. To permit the so-called "man in the street" to say whether he shall or shall not permit the carrying out of some important piece of civic hygiene is to introduce a principle subversive of all system and obstructive of all progress in the science of public health. It is absurd that in a case like this the pronouncements of the judges are to be submitted to the criticisms of the jury. England has already had one or two pretty severe lessons through allowing such places as Gloucester and Leicester to exercise their right of private judgment on the question of vaccination. In Gloucester where there was at one time a vigorous anti-vaccination movement, a serious epidemic overtook the city a few years ago (1896). What science pro-

nounces to be beneficial, the layman must submit to. What we want in these days is less superstition and more faith—in science. I am informed that there are more than 2,000 unvaccinated children in the schools of this city at the present moment, and all because a piece of legislation allows any unintelligent, prejudiced or credulous parent to decide on the momentous question of the vaccination of his children.

Our quarantine regulations are extremely strict, and rightly so, on the subject of smallpox; but is it not a farce to take so much trouble about the health of our immigrants when inside the city we are all the time encouraging a high degree of receptivity towards this very disease? I should call this a very clear case of straining at the international gnet and swallowing the municipal camel. The community at present is at the mercy of its least instructed members. A most sensible suggestion is that if an outbreak of smallpox occurs in Halifax, the cost of it should be borne by the unvaccinated and by the anti-vaccinators. The fact is we have forgotten what smallpox is like. In 1796 before Jennerian vaccination, the death-rate from smallpox in England was 18.5 per cent. of deaths from all causes; in London between 1838 and 1869 it was 1.4 per cent., while in 1871—the worst year for smallpox since vaccination became compulsory—the deaths from smallpox were barely 4.5 per cent. of deaths from all causes, a proportion which was exceeded 93 times in the eighteenth century. At the present moment the deaths from smallpox in London constitute a little under 0.24 per cent. of deaths from all causes, or 77 times less than in pre-Jennerian times.

According to MacVeil, in the pre-vaccination period smallpox was nine times as fatal as measles and seven and one half times as fatal as whooping cough. To-day in the vaccinated community its fatality is negligible, in the unvaccinated it is as high as it was in the Middle Ages. In the city of Berlin, where vaccination is absolutely compulsory, there is no smallpox hospital at all; the cases of smallpox in that city being only a few unvaccinated foreigners. In 1912 the deaths in New York City were as follow: 671 from measles, 614 from scarletine, 500 from typhoid fever, 187 from whooping cough and 2 from smallpox.

In London there were in 48 years of the seventeenth century no less than 10 epidemics of smallpox; in the whole of the eighteenth, 19; and in the nineteenth no epidemic at all during which smallpox was responsible for more than one tenth of the deaths from all causes in any one year.

In Sweden, the highest death-rate before vaccination was 7.23 per 1,000 persons, the lowest 0.30; under permissive vaccination the highest was 2.57, the lowest 0.12; under compulsory vaccination the highest was 0.94, the lowest 0.0005.

It is so frequently said that the disappearance of smallpox is due not to vaccination, but to improved general hygiene, that we must look into this criticism with some care. In the first place, a large diminution in the mortality from smallpox occurred before there was any great change in the unsanitary conditions of the English towns, before there was any enforcing of the isolation of patients either in hospitals or in their own homes. Since the introduction of vaccination, measles and whooping cough still remain in the status quo ante, while smallpox has been exterminated in all fully vaccinated communities, these two diseases of children are as prevalent as ever in England even although the general sanitary conditions have been immensely improved in that country. Of course the effects of vaccination wear out in time, and that is why it is well to be revaccinated once or twice. Now there has been a remarkable progressive change in the age-incidence of smallpox "which can only be explained," says Dr. Newsholme, "on the assumption that vaccination protects children from smallpox and that the protection diminishes, though it never entirely disappears, as age advances."

The "conscience clause" should be immediately removed from the act in which it was inserted on the grounds that it is weak and reactionary in principle, not in the interests of the development of the legislative aspect of the science of public health, and that it permits in certain unintelligent communities quite a considerable number of unvaccinated children to grow up as a permanent menace to their town and district.

When the history of medicine becomes more widely known, when the principles of prophylactic inoculation are more generally understood, when respect for science is the rule rather than the exception, when great achievements in the saving rather than the destroying of life are objects of national veneration, then we may hope to see the day when it will be unhesitatingly admitted that the discovery by Dr. Edward Jenner, the Englishman, was one of the most momentous in the history of the human race, and that his life was one of the noblest, most unselfish and, in its far-reaching effects, most important that has ever been lived on this planet.

