the character of Dr. Edward Jenner is one of the most interesting and remarkable to be found on the records of medical history. Born in a quiet country town, of parentage of intelligent and high moral or religious qualities, and spending his childhood and youth under the same influences in the midst of his native groves and meadows it was natural that he should develop a passionate love of nature and a marked reverence for nature's great Architect. And receiving his general education, not in the higher colleges or universities, but in the more quiet though excellent local schools near his parental home, still further tended to foster that fondness for the study of natural history and, indeed, all the natural sciences in which he became proficient in after life. No other environment or influences could have been better calculated to develop into unusual prominence the three most remarkable traits in the character of Dr. Jenner, namely, his love of nature and all that is truthful and good, his benevolence or unselfish desire to prevent or relieve human suffering, and his patient and persevering pursuit of whatever promised to result in material benefit to mankind. The last-named element of his character has been amply illustrated by what has already been said of his more than twenty years of earnest pursuit of a reliable preventive of smallpox, regardless of the indifference of his professional brethren generally, and of the positive jeers of some of those most nearly in association with him. His love of nature and genuine reverence for the author of all good is admirably illustrated in a letter to a friend written when the evidences of the genuineness of his discovery were nearing completion. He says: "While the vaccine discovery was progressive, the joy I felt at the prospect before me of being the instrument destined to take away from the world one of its greatest calamities, blended with the fond hope of enjoying independence and domestic peace and happiness, was often so excessive, that in pursuing my favorite subject among the meadows, I have sometimes found myself in a kind of reverie. It is pleasant to me to recollect that these reflections always ended in devout acknowledgements to that Being from whom this and all other mercies flow."

But the most vivid illustration of Dr. Edward Jenner's unselfish nature and of his noble conceptions of the true objects of human life is found in his answer to the most tempting inducements to leave his native town and enter upon a professional contest for wealth and fame in the great city of London. We are assured by his biographers that after the full demonstration of the truth of Dr. Jenner's discovery by Mr. Cline, the latter urged him to settle in London, promising him £10,000 (\$50,000) per annum as the result of his practice.

To this, however, his deliberate reply was: "Shall I, who even in the morning of my days sought the lowly and sequestered paths of life, the valley and not the mountain; shall I, now my evening is fast approaching, hold myself up as an object for fortune and fame? Admitting it as a certainty that I obtain both, what stock should I add to my little fund of happiness? My fortune, with what flows in from my profession, is sufficient to gratify my wishes; indeed so limited is my ambition, and that of my nearest connections, that were I precluded from future practice I should be enabled to obtain all I want. And as for fame, what is it? A gilded butt, forever pierced with the arrows of malignancy."²

Did the combined temptations of offered wealth and fame ever receive a more fitting reply? And has there ever been penned a more stinging rebuke to the manifest commercial, money-making, fame-seeking spirit pervading the ranks of the profession of the present day. To have an intelligent appreciation of the beauties, the harmonies and the beneficence of nature, with genuine reverence for nature's great Architect; to labor diligently for the prevention and relief of human suffering, and the elevation of the race; and at the same time to be content with a competence sufficient to supply all our real wants, is not only a true exemplification of the letter and spirit of our national code of medical ethics, but it is equally an exemplification of the only sure road to human happiness here or hereafter. Such was preëminently the life and character of Dr. Edward Jenner, one of the noblest benefactors of the human race.

For an account of the present status of vaccination in our country, and the chief obstacles in the way of realizing all the benefits its faithful and universal application would confer, I refer you to the members of the various parts of this widely extended country who are expected to take part in the discussion which is to follow.

However, as the shades of sixty years of professional toil and 80 years of life are already upon me, and I may never again have an opportunity to address you even by proxy, I must be allowed to remind you that I deem this to be the true semi-centennial of this great national Association; and to congratulate you on the substantial accomplishment of the leading object which prompted its formation, namely, the placing of our system of medical education on a broader, more systematic and more efficient basis. I am filled with contentment and thankfulness that I have been permitted to live until this day. And I sincerely thank you for so patiently listening to this address.

ORIGINAL ARTICLES.

SCIENTIFIC RESEARCHES RELATING TO THE SPECIFIC INFECTIOUS AGENT OF SMALLPOX AND THE PRODUCTION OF ARTIFICIAL IMMUNITY FROM THIS DISEASE.

Read at the Forty-seventh Annual Meeting of the American Medical Association, held at Atlanta, Ga., May 5-8, 1896.

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Gentlemen:—A complete review of the experimental researches which have been made with a view to demonstrating the exact nature and biologic characters of the specific infectious agent which by its multiplication in the body of a susceptible individual gives rise to the disease known to us as variola, or smallpox, would require a volume. But at the end of this volume I would be obliged to record as the principal conclusion reached, the fact that the specific infectious agent in this disease has not been demonstrated. It does not follow from this statement that the researches made have been without value. If this were so I might dismiss this portion of my subject without further remark. But the present occasion calls for something more than this; for, while we

² See Vol. II., Medical Portrait Gallery, Port. Edward Jenner.

are here chiefly to celebrate the centennial of Jenner's great discovery and to consider the beneficent results which have followed its extended application in the civilized countries of the world, we must also give attention to the unsolved problems connected with vaccination, and by a brief review of the literature relating to these problems endeavor to ascertain in which direction our efforts should be turned in future, with a view to their solution.

The principal problem which confronts us is the one already stated. What is the nature of the specific infectious agent? That it is a living microorganism of some kind can scarcely be doubted when we consider the general arguments in favor of a *contagium vivum* in infectious diseases, in connection with our exact knowledge of the etiology of a considerable number of these diseases. But it is proper, in this connection, to call attention to the fact that in the group of infectious diseases to which smallpox belongs—the eruptive fevers—no demonstration has yet been made as to the precise nature of the microorganism which we believe to be present in the infectious material by which these diseases are propagated. The demonstration that certain infectious diseases of man and of the lower animals are due to the presence of bacteria, having specific morphologic and biologic characters by which they can be differentiated one from another, led for a time to the inference that all infectious diseases must be due to the presence of microorganisms of the same class. But the negative results which have attended the extended researches already made give support to the view that the eruptive fevers must be due to microorganisms of a different class, inasmuch as our staining and culture methods fail to demonstrate the presence of specific bacteria in the blood or tissues. Bacteria have, however, been found in the blood and tissues, in a certain proportion of the fatal cases, in the diseases of this group; and these were supposed by some of the earlier investigators to bear an etiologic relation to the diseases in question. But the more precise methods of investigation introduced by Koch have made it evident that these bacteria are not directly concerned in the specific disease processes, and that they are to be regarded as accidentally present, or as representing a secondary infection. The bacteria found under these circumstances are for the most part micrococci, and especially the well known pus cocci—*staphylococcus pyogenes albus*, *staphylococcus pyogenes aureus*, and *streptococcus pyogenes*. The frequency with which these cocci are found in the eruption of variola and of vaccinia, both in the vesicular and in the pustular stages of development led to the description, by Cohn, of his *micrococcus vaccinae*. The description, as given in my translation of Magnin, published in 1880, is as follows:

"*M. vaccinae*, Cohn (*Microsphaera vaccinae*, Cohn.) Very small micrococci, $=0.5 \mu$ scarcely, isolated or united in pairs in recent vaccine virus and in the pus of variola pustules. By cultivation, chaplets of from two to eight cells may be obtained, then masses containing sixteen to thirty-two cells of 10μ and more in diameter." According to Cohn the micrococci of vaccine virus and of variola were to be regarded as different races of the same species. Evidently his conclusions were based upon insufficient data and preconceived notions. But it must be remembered that at the time they were formulated Koch had not yet resorted to the use of solid culture media and the

plate method for the differentiation of bacteria; and the essential requirements of a scientific demonstration of the etiologic relation of a microorganism to a specific infectious disease had not been stated by him, or generally recognized by those engaged in bacteriologic researches. Subsequent investigations have shown that various micrococci and bacilli are found in the pustules of smallpox and in vaccine lymph, and that no one of these, when isolated in a pure culture, will cause the development of a typical vaccine vesicle. Researches relating to the bacteria present in vaccine lymph were greatly stimulated by the offer, by the Grocer's Company of London, of a prize of £1,000 for the discovery "of a method by which the vaccine contagium may be cultivated apart from the animal body in some medium or media not otherwise zymotic—the method to be such that the contagium may by means of it be multiplied to an indefinite extent in successive generations, and that the product after any number of such generations shall (so far as can within the time be tested) prove itself of identical potency with standard vaccine lymph." This offer was made in May, 1883, but up to the present time, so far as I am informed, the prize has not been awarded.

Among those who were induced to make researches in competition for the Grocer's Company prize we may mention Dr. John Dougall, Health Officer of Glasgow. His "Competitive Essay" is published in the Glasgow Medical Journal of December, 1886, and January, 1887. He obtained cultures of micrococci from vaccine lymph, in the various media employed in his investigations, and made numerous vaccinations with these cultures. Some of these appeared to be attended with partial success, but his critical review of his own experiments shows that this apparent partial success was due to the fact that "natural and artificial lymphs (cultures) were nearly always used simultaneously, on the same arm, and in close proximity, and it was found that when artificial lymph proved successful (?) the vesicle was nearly always small and imperfect." In his "conclusion" Dr. Dougall says: "The results of this inquiry, based on the foregoing experiments, do not fulfill the terms of success in solving the announced problem. In other words, I have failed to cultivate vaccine lymph in artificial soils." Dr. Dougall, not being an experienced bacteriologist, apparently assumed that the micrococci obtained by him from vaccine lymph were all of one species; at least he gives no account of an attempt to differentiate species by the plate method. This differentiation has been made, however, by other bacteriologists. Thus Copeman (1891) says:

"As it was evident that more than one organism could usually be obtained by the inoculation of lymph into nutrient media, plate cultivations were made with the object of separating out the different varieties present, both gelatin and glycerin-agar being used for this purpose. In this manner I succeeded in obtaining pure growths of various microorganisms, of which those which almost invariably occurred included micrococci apparently much resembling, if not identical with, the following: 1, *M. pyogenes aureus*; 2, *M. cereus flavus*; 3, *M. epidermis* (? *Staphylococcus albus*, Klein).

"In these observations I find my experiments are in agreement with those of Pfeiffer, while doubtless these various micrococci correspond respectively with Buist's so-called orange, yellow, and white vaccine. In addition, I occasionally found another organism,

which from its morphologic and microscopic characteristics, I believe to be streptococcus pyogenes. In order to test what action, if any, these various microphytes were capable of exerting, they were inoculated, both in pure culture and mixed in various proportions, not only on the calf, but on the human being and on the rabbit, since this latter animal is apparently susceptible to vaccination performed in the ordinary manner. Such inoculations, for the most part, produced little or no effect, although inoculations of streptococcus pyogenes alone occasionally caused the appearance of a small circumscribed inflammatory patch around the point at which it was inserted. In one instance, also, a rabbit died, apparently of septicemia, after inoculation of a mixed growth of the various organisms previously mentioned together with a certain amount of broth in which they had been grown. In the whole series of inoculations, nothing resembling a vaccine vesicle was seen, so that it was, apparently, pretty certain that none of the organisms that had been isolated in the manner described could be directly concerned in the causation of vaccinia."

Pfeiffer, in addition to staphylococcus pyogenes albus, which was most constantly present, obtained the following species: Staphylococcus pyogenes aureus, occasionally; staphylococcus cereus albus, very frequently; four species of sarcinae (*S. lutea*, *S. tetragonus*, *S. aurantiaca* and *S. muscopus*), occasionally; proteus vulgaris and certain non-liquefying bacteria, occasionally. He also found occasionally in human lymph, and always in calf lymph, a species of saccharomyces.

Crookshank (1891) obtained from calf lymph the following bacteria: Specimen No. 1 yielded a torula, bacillus pyocyaneus and bacillus subtilis; No. 2, a bacterium, a variety of proteus, staphylococcus pyogenes aureus, yellow bacterium; No. 3, a bacterium, micrococcus, yellow bacterium and torula; No. 4, yellow micrococcus, white micrococcus, white torula, yellow sarcina, white diplococcus, staphylococcus cereus albus, and a mold fungus; No. 5, yellow sarcina, staphylococcus pyogenes aureus, yellow micrococcus, white bacillus, staphylococcus pyogenes albus, large white micrococcus, yellow bacterium, and a white micrococcus. Among the specimens of human vaccine lymph, No. 1, contained a white micrococcus, proteus and staphylococcus pyogenes aureus; No. 2, a micrococcus, a tetracoccus, a white liquefying micrococcus, and a yellow bacterium; No. 3, white micrococcus, yellow micrococcus, staphylococcus aureus and flavus, a bacterium, a white micrococcus, a bacillus resembling bacillus subtilis, staphylococcus pyogenes aureus, and a brown tetracoccus. Crookshank concludes that none of these bacteria are peculiar to vaccine lymph; "there was no bacterium constantly present in human and calf vaccine, and there was not one which could be regarded as the contagium. To sum up, most of them were well known saprophytic bacteria, and some were identical with bacteria commonly found in suppuration."

The experiments of Carstens and Coert (1878) show that the specific virulence of vaccine lymph is destroyed by ten minutes' exposure to temperature of 54 degrees C. And the writer's experiments (1879) show that various disinfecting agents tested—chlorin, sulphur dioxide, nitrous acid—destroy the infective virulence of lymph dried upon ivory points in about the same proportion as is required for the destruction

of some of the best-known pathogenic bacteria. But this does not prove that virulence depends upon the presence of a living microorganism, however probable this appears, for certain toxalbumins are likewise destroyed by a correspondingly low temperature and by the action of various chemie disinfectants.

Nikolsky (1892) obtained from the base of the pustules of smallpox a motile, liquefying, spore-producing bacillus which when introduced into the peritoneal cavity of rabbits is said to have given rise to a pustular eruption; the bacillus was recovered in cultures from these pustules. Grigorijew (1889) in three cases found a small bacillus, twice as long as thick, which slowly liquefied gelatin, and did not coagulate milk. Besser (1893) gives an account of the microorganisms found in the pustules of variola and adds to the list a bacillus found by himself in a single case. This does not grow in gelatin at the room temperature and is more slender than the bacillus of Grigorijew.

The results of the researches of Martin (1891) have been reported by Ernst (1893). He obtained various bacteria from the lymph of vaccine vesicles, and among these was a bacillus which he believed to be the specific infectious agent. This he was able to cultivate upon the surface of sterilized blood-serum of the ox, at 37 degrees C., and his cultures of the ninth generation are said to have produced typical cowpox when inoculated upon calves. He says: "The material 'takes' with the same certainty as the lymph from the vesicle. From the vesicles produced by it upon the calf I have vaccinated a number of children, in every case inducing vaccinia of the most perfect type." He also says with reference to his cultures: "These cultures, however, were not pure, but contained quite a variety of bacteria. In every instance the blood-serum was liquefied." As to the morphology he says: "The bacterium varies in form according to the various conditions of its nutritive environment and the consequent rate of its development. The most constant and prevalent form is a short, fine bacillus with rounded or nearly square ends. Those parts of the culture where the nutriment is apparently exhausted show the same bacilli in short chains, longer bacilli, and bacilli much enlarged at one end or the middle, as if in preparation for spore formation." As Martin's cultures were not pure we have no evidence that his successful inoculations were due to the particular bacillus which attracted his attention. Possibly a microorganism of another class was also present and was carried over from one culture to another. Ruete and Enoch (1893) have also reported successful vaccinations in the calf with a micrococcus which they cultivated from vaccine lymph.

Buttersack (1893) as a result of his researches arrived at the conclusion that there are numerous minute elements in vaccine lymph which do not stain and are sometimes arranged in chains. The subsequent researches of Landmann (1894) and others indicate that the supposed microorganisms of Buttersack are non-living albuminoid granules, artificially produced by his method of investigation. This view is confirmed by the investigations of Dräer (1894).

Guarnieri (1892), Monti (1894), Piana and Galli-Valerio (1894), and Clarke (1895), have observed ameboid microorganisms in the pustules of variola and in vaccine lymph which may prove to be the specific infectious agent in this disease. These are

described by Guarnieri under the name *cytocyetes variolæ* and *cytocyetes vacciniæ*. According to Clarke these ameboid parasites belong to the sporozoa. E. Pfeiffer (1895) has studied this parasite by inoculations into the cornea of rabbits, guinea pigs and calves.

Wassermann has recently (1895) reported his failure to obtain microorganisms in cultures from the variola pustules. He says: "At the suggestion of my highly honored chief I have made a bacteriologic examination of the variola pustules in cases 1, 2 and 4. Herr Geheimrath Koch had the kindness to inform me that he himself formerly in numerous cases, in which he made a similar investigation, had constantly found the contents of the pustules sterile. This I am able to verify from my own investigations. Naturally it is necessary to work with aseptic precautions. For this purpose the surface of the pustules was cleaned with alcohol and ether, and the contents then withdrawn with a capillary pipette. In this manner I obtained material from the pustules in all stages of their development, not only serum but also pure pus. This was cultivated upon human blood-agar, serum-agar, serum, and dextrin-serum-agar, both under aerobic and anaerobic conditions, *but all of these culture media remained sterile*, no microorganisms grew."

In certain cases of hemorrhagic smallpox Koch found constantly in the contents of the pustules a streptococcus—probably *S. pyogenes*—which no doubt represented a mixed infection.

That none of the bacteria which have been cultivated from vaccine lymph have anything to do with its specific virulence is indicated, not only by the fact that the inoculation of pure cultures of these various microorganisms gives a negative result, but also by the fact that vaccine lymph when mixed with glycerin after a time becomes sterile, so far as these microorganisms are concerned, without losing its power to produce a typical result when tested upon a susceptible individual. Copeman, has shown that such admixture, after a time, destroys the vitality of the micrococci and other bacteria present in the lymph, and that virus preserved in this way until it is sterile, as proved by culture experiments, is even more active than when first obtained. Copeman's conclusions have been confirmed by the independent observations of Cambon and Ménard, of Prof. Straus and others. And this method of preserving lymph is coming into general use. It has the manifest advantage of excluding the pus cocci and thus preventing the unpleasant complications which result from inoculating these pathogenic micrococci at the same time with the vaccine lymph. No doubt the excessive tumefaction, erysipelatous inflammation and ulceration which often result from vaccination are chiefly due to inoculation with these micrococci and especially with *staphylococcus pyogenes aureus* and *streptococcus pyogenes*. According to Prof. Straus glycerinated lymph which when fresh gave numerous colonies of various bacteria, including especially *staphylococcus pyogenes albus* and *aureus*, at the end of fifty to sixty days was found to be absolutely sterile. This method of excluding extraneous microorganisms should be employed by future investigators, who will thus have the advantage of conducting their experiments with a, presumably, pure culture of the vaccine microbe.

It seems to me, also, worth while to make some

experiments to determine whether successful vaccination can not be made, with such lymph, by a method which would insure the exclusion of bacteria from the locality into which the vaccine virus is introduced, thus giving an aseptic result. This would be readily accomplished if subcutaneous injection of the glycerinated virus could be substituted for the usual method of superficial scarification. That this may be possible is suggested by the experiments of Chauveau. In a paper published in 1877, eleven years after the publication of the report of the famous commission of which he was president, he says:

"When, in place of inserting the vaccine virus into the rete mucosum of the skin, we cause it to penetrate by way of the subcutaneous connective tissue, the virus manifests its action by two kinds of positive effects common to the three species" (man, horse and cow) "a more or less pronounced local tumefaction is developed, and the subjects acquire the vaccinal immunity exactly as if they had been vaccinated in the classic way."

The experiments of Raynaud (1877) led him to a similar conclusion. He says: "As regards the vaccinal pustule: The evolution of this pustule" (bouton) "is not necessary in order that immunity may be induced. This is produced after a subcutaneous inoculation, even when the development of the vaccine pustule is prevented."

Having briefly reviewed the evidence relating to the presence of microorganisms in the virulent material by which variola and vaccinia are transmitted from one individual to another I must now invite your attention to the second subject included in the title of my paper, viz.: *Scientific researches relating to the production of artificial immunity from this disease.*

In Jenner's "Inquiry," published in 1798, he gives an account of the observations and experiments which led him to the conclusion that cowpox results from the transfer of infectious material from "the heels of a horse affected with the grease"; and that when transmitted to the human subject, by contact in milking with the pustules upon the "nipples of the cows," "the person who has been thus affected is forever secure from the infection of the smallpox; neither exposure to the variolous effluvia, nor the insertion of the matter into the skin, producing this distemper." We now know that Jenner was mistaken in his inference that vaccination protects from smallpox during the lifetime—"forever after"—of the individual. It is generally recognized by physicians that the protection afforded is not absolute and that it is not permanent. Hence the necessity for revaccination, after an interval of several years, when smallpox is prevalent in a community. The fact that a single attack of smallpox is not always protective would lead us to expect that the immunity from vaccination would not be absolute, and experience shows that in every smallpox epidemic a certain number of persons who have been vaccinated fall victims to the disease; but experience also shows that the mortality among the vaccinated is very much less than among the non-vaccinated. The London Board of Health, from thirty returns sent to them—not selected—has given the following table:

	Number of Cases.	Deaths.	Percentage of Deaths.
Natural smallpox in the unprotected	1,731	361	20.85
Smallpox after smallpox	58	22	37.92
Smallpox after vaccination	929	32	3.44

The gradual loss of immunity from vaccination, as determined by revaccination, is shown in the following figures, which are given in a recent (1894) paper by Biedert. In the year 1889 smallpox was introduced into Hagenau, and twenty-one cases occurred. The physician charged with that duty revaccinated all of the school children with the result given below:

Age.	Number Vaccinated.	Successful.	Per cent.
6 to 7	288	94	33.0
7 to 8	292	187	63.8
8 to 9	222	161	72.5
9 to 10	221	176	80.0
10 to 11	306	273	85.8
11 to 12	413	367	88.6

We may remark in connection with this table that in Germany vaccination is compulsory, and all children must be vaccinated before the September of the year following their birth. All scholars who have not had an attack of smallpox must be revaccinated when 12 years old.

Questions relating to the practical application and results of Jenner's method of prophylaxis do not come within the scope of the present paper. But we must give some attention to a question of great scientific interest, which has been repeatedly investigated by the experimental method and upon which, nevertheless, divergent views are still held by members of the profession who have made a critical study of this evidence. The question is whether cowpox and horsepox are modified smallpox, as maintained by those who accept the evidence of successful inoculations, afforded by the experiments of Gassner, Ceely, Badcock and others, or whether these diseases are quite distinct and independent of each other as maintained by Chauveau, Fleming, Crookshank and others, who give reasons for believing that this evidence is unsatisfactory. The arguments in support of this last-mentioned point of view are so concisely stated by Fleming¹ that I shall take the liberty of quoting a considerable portion of his letter to the editor of the *Lancet* (Nov. 20, 1886). He says:

"For many years now, the medical profession in this country seems to be generally agreed that human variola and cowpox are one and the same malady, the latter being merely smallpox modified through transference to the bovine creature. In books, letters and lectures there is evidence of this belief, and the latest proof of its existence is to be found in the Harveian Oration recently delivered by Dr. Pavy, in which we find the following statement: 'It may now be regarded as an accepted conclusion that vaccine lymph is the virus of smallpox, modified by transmission through the cow.' If it be not rank heresy to throw doubts on a conclusion accepted by such high authorities in human medicine as Dr. Pavy represents, will you kindly allow me, a very humble student of animal medicine and comparative pathology, to dissent from this generally accepted conclusion, and to express strong doubts, or even entire disbelief, as to the one malady being merely a modification of the other. The question would not, perhaps, be of so much moment had not at least three serious accidents resulted from carrying the above conclusion into practice; and as more disasters may yet be due to the same notion, I submit that it is high time the supposed facts upon which it is based should be examined in order that the truth may be arrived at. The

most notable authority for the statement made by Dr. Pavy, in this country at least, was my old friend, the late Mr. Ceely, of Aylesbury, who reported that he had succeeded in producing cowpox by inoculating a cow with smallpox matter. But it must be remembered that he, at the same time, was experimenting with vaccine lymph, and the great probability is that he employed the latter when he thought he was using the former. At any rate, he never afterward succeeded in repeating his presumed success, though his subsequent trials were made under the most favorable conditions. The last attempt was undertaken not long ago, and only a short time before his death. On that occasion twelve heifers were purchased by the local government board and lodged in the Brown Institution, where they were inoculated by Dr. Klein, under the supervision and direction of Mr. Ceely; and though smallpox matter was literally poured into the incisions and the greatest care was observed throughout, yet cowpox was not developed in any of the animals. Similar failures have attended all other attempts, when these have been made openly and by two or more individuals. I may allude to those of the French commission, which included some of the most distinguished members of the medical profession in Paris, with the able veterinary surgeon, Chauveau, as operator; and the Italian commission, whose labors were carried on at Turin on a large scale and for a long time. All in vain, however, for smallpox could not be converted into cowpox, and the conclusion arrived at was in direct opposition to that which Dr. Pavy asks us to accept.

"Dr. Pavy speaks of the smallpox virus becoming attenuated in the cow, and that this attenuation manifests itself as cowpox. But if inoculation of the former produces the later, then I contend it is not attenuation, but absolute and permanent transformation of the most startling and complete description, and such as can not be effected with any virus or microbes known. We are required to believe that by one remove of human smallpox—most infectious, fatal and generally eruptive disease—to the cow, we have produced a non-fatal disease, which can only be transmitted by inoculation, with an eruption quite localized at the points of inoculation, and otherwise widely different in its clinical and pathologic features, especially with regard to the eruption. Most astonishing of all, however, is the circumstance that this modified or attenuated smallpox, when carried back to its original soil in mankind, never resumes its original characteristics; no matter though it be carried through countless generations of human beings, it remains forever in its transformed condition. This does not happen with an attenuated virus, nor can any virus, by any artifice of man, become so utterly changed. Again, we all know how readily vaccine lymph, when inoculated in the calf or cow, will produce vaccinia. As I have pointed out, all attempts to develop the latter by inoculating these animals with variolous matter have resulted in failure, when made by those most competent to achieve success, if this were possible."

In support of the opposite and generally accepted point of view, I may be permitted to quote from an abstract of a paper by Copeman,¹ read before the Epidemiological Society of London, April 9, 1893:

"Whatever doubts might attach to some, especially

¹ Geo. Fleming, LL.D., Principal Veterinary Surgeon of the Army.

¹ S. A. Moncton Copeman, M.A., M.D., Medical Inspector, Her Majesty's Local Government Board, etc.

of the earlier attempts, and to those in which there was a suspicion of concurrent retro-vaccination, he was firmly convinced that Badcock, Ceely, Thiele and others in the past, as well as Voight, King, and above all Haccius, within the last ten years had repeatedly succeeded in transforming the lymph of typical variola into the best vaccine by successive transmissions through the bovine organism. In the earlier terms of such series it retained much of the virulence or activity of variola, but was even then essentially changed in being no longer communicable otherwise than by actual inoculation.

"In the cases on which the Lyons school relied in their denial of such transformation of variola into vaccinia the lymph or pus had not been absorbed and consequently was in no way modified, but the very same matter that had been inserted in the calf being afterward inoculated into the child naturally reproduced unmitigated smallpox.

"Haccius' experiments were, however, absolutely conclusive and unimpeachable, proving that vaccinia was but a modification of variola consequent on its cultivation in the cow."

The results obtained by Haccius and Eternod, which Copeman accepts as conclusive, are stated by the authors referred to as follows:

"In the first place, we affirm, that after having inoculated calves with variola virus, from seven different sources, and obtained from cases more or less grave, we have obtained every time, after the second or third generation"—i. e., the second or third successive inoculation—"pustules which differed in no way, in their appearance, from the vaccinal pustules originating from cowpox.

"Our experiments show that the result of inoculations varies according to the method employed for introducing the virus. Scarifications and denudations alone have given useful eruptions, while incisions and subcutaneous punctures, such as are usually practiced, have given no result, or have only given rise to small red nodules, not suitable for propagation.

"It results from these facts that the inoculation of human variola in bovine animals causes two kinds of eruption, one which may be propagated and the other which can not.

"The eruption which can be cultivated does not give at the outset a vaccinal pustule having all of the typical characters. It requires, in general, to be transmitted through several successive generations in order to acquire them."

With reference to the successful results obtained by Badcock and by Ceely, we quote from a paper in the *British Medical Journal* (Nov. 26, 1881) by Dr. Hodgson, as follows:

"Although often failing afterward, it was Mr. Badcock's good fortune to have a first success. Obtaining from the late Sir (then Mr.) Cordy Burrows some lymph from a primary case of human smallpox, he inoculated a cow with it, and produced (in the judgment of Dr. Willis and Mr. Burrows) such perfect vaccine vesicles, that he has induced therefrom to vaccinate his own baby, and with the result again satisfying the medical men that genuine vaccine pocks occurred on the little boy's arm. From these, in turn, a supply of lymph was obtained, and was propagated on other children, uniformly with the same results; many other medical men taking part in the proceedings, or using the new lymph in their practices.

"Mr. Badcock's enthusiasm carried him forward, and led him, notwithstanding many failures and disappointments, to incur considerable expense in keeping up a stock of cows on which to continue his experiments. For twenty successive years did he persist from time to time, as opportunity offered, procuring through medical men fresh supplies of variolous matter, and using it on the cows. Altogether, he practiced on two hundred cows.

"Several of the two hundred animals he inoculated repeatedly. In only thirty-seven instances were satisfactory vaccine pocks considered to result; indeed, in four of these, they were not so finely developed as to encourage a transference from them of their contents. Consequently, the total number of cases in which typical vaccine pocks were produced, and which were considered eligible for vaccinating from (during the twenty years' experiments), was thirty-three. These successful cases were watched, in different stages, by various medical men, many of whom were public or practical vaccinators highly qualified to decide on their merits; and the lymph so obtained has been circulated throughout the civilized world. It continues to be held in high esteem in Brighton, where the three public vaccinators have each of them received gifts from the government three several times for the high standard of their vaccinations.

"The late Mr. Marson used Mr. Badcock's lymph for many years, and so did the late Mr. Ceely. The latter and Mr. Badcock commenced their experiments in the same year, unknown to each other; and Mr. Ceely, having succeeded twice only himself, afterward visited Brighton, and, having satisfied himself of the thorough reliableness of Mr. Badcock's doings, then ceased personally to experiment further—the more readily so, in consequence of the arduousness of his other occupations as a country hospital surgeon and general practitioner.

"Sir Thomas Watson and Dr. Bristowe, in their text-books on the practice of medicine, have both accepted Ceely's and Badcock's investigations, as furnishing the true bearing of cowpox to smallpox; and, as long ago as 1857, in the ponderous 'Blue-book' on vaccination, compiled under the superintendence of Mr. Simon, he thoroughly does the same. These are extracts from his report. 'Researches, subsequent to Jenner's, have settled this part of the question. It has been made matter of familiar experiment that the infection of smallpox may be communicated, by inoculation, from man to the cow, producing vesicles which present the physical characters of cowpox; and that the lymph from these vesicles, if implanted in the skin of the human subject, produces the ordinary local phenomena of vaccination, from which lymph may be transferred to other unprotected persons, all of which human beings will diffuse no atmospheric infection, and will afterward themselves cease to be susceptible to smallpox. The people thus protected are so, because the process has really given them smallpox of the most mitigated kind. The merit of this discovery belongs in the first place, to Gassner, in 1801; and, of corroborating it, in 1840, to Ceely and Badcock. The last mentioned has, during the last seventeen years, again and again derived a fresh stock of vaccine lymph from cows thus artificially infected by himself; has vaccinated with such lymph more than fourteen thousand persons, and furnished supplies of it to more than four hundred medical practitioners.'

The time at my disposal will not permit a more extended review of the experimental evidence: but in view of the positive results already referred to I believe we are justified in accepting it as a demonstrated fact that cowpox and smallpox have a genetic relation and that cowpox may be induced by inoculations with smallpox virus. The negative results which have so frequently attended such inoculations can not be accepted as establishing the contrary view. While this question could only be settled definitely by experimental evidence, we may call attention, as corroborative of the conclusion reached from an examination of this evidence, to the support which it receives from the demonstrated fact that both in man and in susceptible lower animals inoculations with the virus from either source confer immunity from the pathogenic action of the other. This cross immunity, so far as we now know, does not occur in infectious diseases which are not genetically related. Another significant fact is the frequency of cowpox in England at a time when smallpox was prevalent in that country, and its comparative infrequency since, as a result of vaccination, the prevalence of the disease has been greatly restricted.

The genetic relation of smallpox and horsepox is established, indirectly, by the experiments of Jenner and others, which show that inoculations of the virus of horsepox, or "grease," will cause the development of typical pustules of cowpox in bovine animals, and that from these a vaccine virus may be obtained which gives rise to typical results in man. Chauveau says that the horse "has a special aptitude to the natural or spontaneous development of the vaccine disease." Its special susceptibility is shown by the fact that a generalized vaccinal eruption, corresponding with that of natural horsepox, not infrequently results from cutaneous inoculations and also from intra-venous injections of vaccine virus. Such injections, according to Chauveau, "not only confer immunity, but quite frequently give rise to an exanthematous vaccinal eruption, the exact *fac simile* of the natural malady."

The experiments of Copeman, Reed and others, show that the monkey is also susceptible to vaccination and that after a successful vaccination it has acquired an immunity from the specific pathogenic action of the vaccine virus.

Reference has already been made to the experiments of Chauveau and of Raynaud, which show that vaccinal immunity may be produced by the subcutaneous injection of vaccine virus. Raynaud has also called attention to the fact that after such inoculations, as well as after vaccination by the usual method, the nearest lymphatic gland is considerably enlarged. The idea occurred to him that the specific infectious element might be retained in these enlarged glands, but he failed in obtaining any positive results from vaccinations with the juice of such enlarged glands. He also had negative results in subcutaneous inoculation made with lymph obtained from the lymphatic vessels between the point of vaccination and the nearest glands. But several grams of such lymph injected directly into the circulation of a horse caused an eruption of horsepox. In his summary of the results of his experiments Raynaud says: "It is then possible, finally, to detect traces of virulence in the lymphatic system, between the place of inoculation and the nearest lymphatic gland. Beyond this gland it is not found. This circumstance seems to indicate that the

glands may be concerned in the disappearance of virulence and the appearance of immunity, two facts simultaneous and correlative."

That immunity may be induced in the calf by intra-venous injections of small quantities of vaccine virus appears to be demonstrated by the experiments of Straus, Chambon and Ménard (1890). Chauveau had previously shown that the horse may be made immune by such injections.

Both Chauveau and Raynaud obtained negative results from their experiments with the blood of vaccinated animals. In a single experiment made in 1877 Raynaud obtained what appeared to be a positive result in a calf into the veins of which he had injected 250 grams of blood from another calf which had been vaccinated six days previously and in which the vaccinal eruption was fully developed. This animal proved to be fully immune, but subsequent experiments did not give a similar result and Raynaud abandoned the view, which he at first entertained, that immunity in this case was due to the transfusion of blood from a vaccinated calf. More recent experiments, however, seem to show that by the transfusion of a very large amount of blood from a vaccinated calf immunity may be induced. The experiments of Straus, Chambon and Ménard gave a successful result when the amount of blood transfused was as much as five or six kilograms.

Béclère, Chambon, and Ménard (1896) report that in their experiments the vaccinal eruption was considerably modified, in the calf, by subcutaneous injections of serum from an immune animal when the total amount injected was from 800 to 1,500 c.c.; also that lymph from the modified vaccinal eruption was attenuated, as regards its specific virulence. That complete immunity is not produced by the subcutaneous or intra-venous injection of amounts varying from 50 to 1,000 c.c. is demonstrated by the experiments of Chauveau, of Raynaud, of Kramer and Boyce, of Beumer and Peiper and of the authors above mentioned.

The successful experiments of Prof. Straus and his associates lead them to conclude that the undiscovered "vaccine microbe" is present in the blood, in very small quantity during the period of eruption—at which time the blood was obtained which served for their experiments. A different explanation of the immunity resulting from the transfusion of so large a quantity of blood suggests itself as more probable, in view of recent additions to our knowledge relating to the production of immunity by antitoxins. If the immunity induced in the experiments referred to was due to the introduction of the vaccine microbe the result would not be likely to depend so largely upon quantity. A microbe capable of self-multiplication, if present in the blood transfused could scarcely fail to be in sufficient numbers to cause general infection when from 250 to 1,000 c.c. of this blood is injected into the veins of a susceptible animal. But in the experiments referred to immunity was not established unless a considerably larger quantity of blood was transfused. The experiments of Béclère, Chambon and Ménard (1896) show that blood collected from a vaccinated heifer some time after the complete dessication of the vaccinal eruption possesses immunizing properties. These results are confirmed by results obtained by Major Walter Reed, Surgeon U. S. A., in experiments on monkeys, made at the Army Medical Museum. Dr. Reed's experiments also show that a considerable

quantity of serum is required in order to establish a complete immunity from the specific pathogenic action of vaccine virus. When the quantity was insufficient a partial effect was noted, the vaccine vesicle appearing at a later date after vaccination, and in some cases showing an imperfect development.

Béclère, Chambon and Ménard have given the following summary of the conclusions reached by them, as a result of their experiments:

"1. The serum of a vaccinated heifer collected ten to fifteen days after vaccination, after the virulent period, possesses immunizing properties.

"2. The immunizing action of the serum of the vaccinated heifer is very rapid. The subcutaneous injection of a sufficient quantity, made immediately before vaccination by numerous sub-epidermic inoculations, modifies the subsequent development of the vaccinal eruption and may cause its almost complete abortion."

"4. The rapidity of the immunizing action of the serum of the vaccinated heifer, compared with the tardy immunity which follows the subcutaneous inoculation of vaccine lymph, demonstrates that the serum owes its immunizing properties to soluble substances and not to the presence of the microbes (still unknown) of vaccinia."

The experimental evidence heretofore referred to seems to support the conclusion last stated and experiments made by the present writer in 1892 show that the soluble substances upon which immunity depends when brought into contact with vaccine virus neutralize its specific virulence—presumably by destroying the vitality of the vaccine microbe. The positive results reported in my paper published (1892) in the *Transactions of the Association of American Physicians*² have since been confirmed by Kinyon and by Reed.

¹ The writer in 1893 made a series of experiments "upon unvaccinated children in two orphan asylums in Brooklyn, with a view to ascertain whether blood serum from an immune calf, or from an individual who had recently suffered an attack of smallpox, if injected into the subcutaneous tissues at the time of vaccination, would prevent the development of a characteristic vaccine vesicle. In these experiments from 1 to 5 c.c. of the serum supposed to contain an antitoxin of smallpox was injected near the point of vaccination, or, in some instances, into the other arm. The result was negative, even when serum was used from an individual who was just convalescent from a severe attack of smallpox. But it may be that a different result would have been obtained if a larger quantity of blood serum had been used, or if it had been injected into the circulation instead of into the subcutaneous tissues. More recent experiments by Kramer and Boyce (1893) and by Landmann (1894) also show that small amounts of serum from immune calves (5 to 10 c.c.) do not prevent the development of the vaccine vesicle; and that blood serum (35 c.c.) from one who had suffered a recent attack of smallpox did not have any noticeable effect upon the development of a confluent case of smallpox in a child 5 years of age (Landmann)."

(Quotation from the writer's work on Immunity, Protective Inoculations in Infectious Diseases and Serum-Therapy. Wm. Wood & Co., New York, 1895.)

² The following extract from my paper entitled "Practical Results of Bacteriological Researches," gives details of the experiments referred to:

"These experiments were made with the kind assistance of Dr. Wm. E. Griffiths, of Brooklyn, who has for many years been engaged in the production of vaccine virus, and consequently is an expert in the vaccination of calves and in recognizing vaccinia in these animals.

"Upon visiting Dr. Griffiths and making known to him my desires, I found him quite willing to assist me, and also that he had recently vaccinated, and consequently immune, calf in his stable. This animal had been vaccinated in numerous places upon the abdomen and thighs fourteen days previously. The vaccination was entirely successful, and a large number of quills had been charged from the vesicles which formed. At the time of my visit for the purpose of collecting blood-serum from this animal, dry crust still remained attached at the points where vaccination had been practiced two weeks previously. On the 28th of April I collected blood serum from a superficial vein in the hind leg of this calf. This blood was placed in an ice chest for twenty-four hours, at the end of which time the clear serum was drawn off in 'Sternberg's bulbs.' Four drops of this serum were placed in each of two small, sterilized, glass tubes; in one of these we placed three quills charged with fresh vaccine lymph from a calf. At the end of an hour the quills were removed, after carefully washing off in the serum the lymph with which they had been charged. In the other tube we mixed with the four drops of blood-serum an emulsion made from a fragment of a perfectly fresh vaccine crust from the arm of a child; this was crushed upon a piece of glass and rubbed up with a little of the same blood-serum. The two tubes were now placed in an ice-chest for twenty-four hours, at the end of which time the contents were used to vaccinate a calf purchased for the purpose. Dr. Griffiths carefully shaved the thighs of this calf and scarified each thigh in several places, as he is accustomed to do in vaccinating for the propagation of lymph. The contents of the tube con-

taining lymph from the quills were rubbed into the scarified places upon one thigh, and the contents of the tube containing the emulsified crust into the other. On the 8th of May, nine days after the vaccination, the calf was carefully examined, and it was ascertained that the result of the vaccination was entirely negative.

"Evidently it was necessary to make a control experiment before we would be justified in ascribing this negative result to a neutralization of the virus by some special substance present in the blood serum of an immune calf. Possibly the blood of a non-immune calf might also, after an exposure of twenty-four hours, neutralize the specific virulence of vaccine lymph. The control experiment was made as follows:

"On the 9th day of May we collected blood from a vein in the leg of a non-immune (not vaccinated) calf; this was placed in the ice-chest for twenty-four hours, and the following day clear serum was collected in Sternberg's bulbs. Three quills, charged with fresh lymph from a calf, of the same lot as those used in the previous experiment, were placed in four drops of this blood-serum in each of two small glass tubes. As in the previous experiment, the lymph was washed from the quills at the end of an hour, and the tubes were placed aside in the ice-chest. At the end of twenty-four hours the serum in these two tubes was used to vaccinate the same calf which had served for the previous experiment. Several points were scarified upon the left thigh and upon the left side of the abdomen, which were carefully shaved for the purpose.

"At the same time the animal was vaccinated upon the right thigh and upon the right side of the abdomen with virus mixed with the blood serum from the immune calf. This serum, collected in Sternberg's bulbs on the 28th of April, had since been kept in the ice-chest. One hour before the vaccination four drops of this blood-serum were mixed with one drop of liquid lymph, which had been recently collected by Dr. Griffiths in a capillary tube from a vaccinated calf. At the same time three quills charged with bovine lymph were immersed in four drops of the same blood serum from immune calf. As stated, the animal was vaccinated upon the right side of the abdomen and upon the right thigh with this virus, which had been exposed for one hour to the action of blood-serum from an immune calf. The serum containing the liquid lymph was rubbed into the scarification on the right side of the abdomen, the serum containing lymph from the quills into the right thigh. On the 19th of May, eight days after the vaccination, the animal was carefully examined by Dr. Griffiths and myself, and the following results noted: Upon the left thigh and left side of the abdomen the vaccinations, from quills in non-immune blood-serum after twenty-four hours' contact—were entirely successful, the scarification being surrounded by characteristic vesicles and covered by characteristic crusts. Upon the right thigh, vaccinations from quills immersed in blood-serum from immune calf for one hour—and upon the right side of abdomen—vaccinations with liquid lymph mixed with blood-serum from immune calf, the result was entirely negative. Several of the scarifications had entirely healed; others were covered with a dry scab which was easily detached and under which the scarification was healing without any appearance of vesicles such as surrounded the scarifications upon the left side."

of blood-serum are required to produce immunity in a healthy animal appears to indicate that a specific therapeutic effect can not be expected from the subcutaneous injection of a few cubic centimeters of serum, or even from the transfusion of several hundred cubic centimeters. As already mentioned, the experiments of Chaveau, of Raynaud, and of Prof. Straus and his associates, upon calves, agree in showing that the immunizing dose of blood-serum is several kilograms, and that the transfusion of less than 1,000 grams usually has no appreciable effect.

In two cases of smallpox treated by Dr. Elliott, with serum collected by Kinyon (1895) the result is supposed to have been favorable, although one of the patients died. This patient received in all 60 c.c. of the serum, in doses of 15 c.c., injected subcutaneously. In the second, non-fatal case, 105 c.c. was administered in the same way "during a period of forty-eight hours." Dr. Elliott says: "There was no effect on the eruption in the first case. It is my opinion that the vaccine serum will shorten the course of variola if given in the papular stage of the eruption. The vaccine serum does modify the variolous eruption, even in the pustular stage, but does not shorten the attack. The most serious objection to its application is the largeness of the dose, 15 to 30 c.c., which leads the patients to object to its use."

Landmann (1894) injected 25 c.c. of blood-serum, from an individual who had recently recovered from an attack of smallpox, into a child, 5 years of age, suffering from an attack of confluent smallpox. No noticeable effect was produced.

Auché (1873) had previously reported a negative result from the subcutaneous injection of serum obtained from recent convalescents—6 c.c. in one case and 18 c.c. in another.

Béclère, Chambon and Ménard, in their recently published paper, to which we have already referred, say that they have made clinical experiments to determine the therapeutic value of blood-serum from an immune animal in seventeen cases of variola, and that the results of these experiments will shortly be published. Possibly their report may be more favorable than we now anticipate.

In view of the large quantity of blood serum required to produce immunity, and, by inference, to have a specific therapeutic effect in smallpox, it is evident that an effort should be made to obtain the immunizing substance in a more concentrated form. Already, Dr. Reed has made some preliminary experiments in this direction at the Army Medical Museum, and he has ascertained that a dried precipitate from the serum of an immune calf, obtained by the method of Brieger and Cohn, contains a substance which neutralizes the action of vaccine virus, when brought into contact with it before vaccination. A comparative test showed that the dried precipitate from the serum of a non-immune calf has no such effect.

The conclusions reached and suggestions made in this paper may be summarized as follows:

1. Smallpox, cowpox and horsepox are genetically related, being different manifestations of the same infectious disease in different genera of animals (Man, Bos, Equus).

2. The specific infectious agent of variola and of vaccinia has not been demonstrated. The extended experimental investigations which have been made indicate that it does not belong to the class of microorganisms known as bacteria.

3. Various bacteria are commonly found in the lymph from vaccine vesicles, obtained either from bovine animals or from man. Among these are the well-known pus cocci, and these micrococci are probably largely responsible for the erysipelatous inflammation and other unpleasant complications which frequently result from vaccination with such lymph.

4. Lymph preserved in glycerin after a time becomes sterile so far as the presence of bacteria is concerned, without losing its specific virulence.

5. Immunity may be induced by subcutaneous inoculation of vaccine virus, without the development of a vaccine vesicle; and it is probable that the subcutaneous injection of lymph preserved in glycerin would give protection without any of the septic complications so common as a result of vaccination by the usual method.

6. The blood-serum of immune animals contains a substance in solution which destroys the specific virulence of vaccine virus when brought in contact with it.

7. This substance is not present in sufficient amount to make the blood-serum of immune animals available for the production of immunity in man (or for the treatment of variola?). But it may perhaps be obtained in a concentrated form by chemical methods, and in that case would be likely to prove useful, and possibly specific as a therapeutic agent in this disease.

8. The immunity resulting from the subcutaneous injection of vaccine lymph, like that resulting from vaccination in the usual manner is gradually developed and is not complete until the eighth day,³ depending, no doubt, upon a multiplication of the infectious agent in the body of the susceptible animal. On the other hand, the immunity resulting from the transfusion of a large amount of blood serum from an immune animal to a susceptible animal is an immediate result of such transfusion.

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VAGINAL HYSTERECTOMY FOR FIBROIDS OF THE UTERUS.

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HISTORICAL.

Vaginal hysterectomy is closely associated in its early history with cancer of the uterus. Greig Smith says, that it is probable that incision of the uterus was practiced by the ancient Greeks, but it is certain that it was subsequently forgotten. Soranus, in his book of "Diseases of Women," who lived in Rome a century before Christ, describes the operation as a surgical procedure for prolapsus. The first authenticated description of vaginal hysterectomy subsequent to this was given by Berengarius, of Bologna, in 1507.

In 1560 Andreas A Crucé performed vaginal hysterectomy. J. Schenck a Grafenberg 1617 (Senn) relates a number of cases in which the uterus was removed through the vagina in whole or in part by ignorant persons who had not the faintest idea as to the difficulty or of the extent and gravity of the operation. In 1792 Saumonier removed an inverted uterus below a ligature. Hildanus 1646, Wrisberg 1785, Bernhard 1824 reported cases of accidental or unintentional removal of uteri by the vagina by careless midwives and others. Intentional removal of the uterus by surgeons have been reported by Zwinger, Vieussen, Baxter, Faivre, Alexander, Hunter, Joseph Clark and Jackson. (Senn.)

The real history of vaginal hysterectomy begins when it was deliberately planned and executed for the relief of definite pathologic conditions. To J. M. Langenbeck in 1813 belongs the credit of opening this page of history. He removed the uterus by enucleation, using neither clamps nor ligatures and his case recovered and lived many years. The post-mortem demonstrated to his incredulous critics the truth of his claim. Sauter, Jan. 28, 1822; Elias von Siebold, April 19, 1823; Holscher, Feb. 5, 1824; Elias von Siebold, again July 25, 1825; Langenbeck, again Aug. 5, 1825; Recamier, July 26, 1829; Langenbeck, again Aug. 18, 1829; Roux, Sept. 20 and Sept. 25, 1830; Recamier, again Jan. 13, 1830; Blundell, Oct. 16, 1830. Siebold 1831, Delbach 1839 are the bold pioneers who followed the lead of Langenbeck in Europe. From 1839 to the revival of Czerny in 1878 there are no records of European cases. In America, however, a few cases were put on record during this long interval. Palmer Dudley reports that Dr. John M. Esselman, of Nashville, Tenn., in September, 1834, removed an inverted uterus by means of the ligature, his patient recovering. This same surgeon repeated the operation successfully in August, 1843, for an inverted uterus containing a fibroid. This is the first vaginal hysterectomy for fibroids of the uterus I find recorded. The first vaginal hysterectomy for cancer deliberately undertaken and successfully executed in this country was performed by Dr. Paul F. Eve, of Augusta, Ga., April 16, 1850. (*Am. Journal of Medical Science*, 1858.) Dr. L. C. Lane, of San Francisco, operated for cancer Nov. 11, 1878, and at a later date in the same year on a second case for cancers. Both cases recovered. Lane executed this operation independently of Czerny, who revived the operation in Europe by performing his first operation April 12, 1878, or seven months earlier than Lane.

From the revival of Czerny and Lane, with the dawn of clean surgery, the operation of vaginal hysterectomy became a legitimate operation. In less than twenty years it has made wonderful strides. It has been performed thousands of times by hundreds of operators, and has, undoubtedly, been the means of adding many years to the sum total of human life.

VAGINAL HYSTERECTOMY FOR FIBROIDS.

It is argued that a patient suffers less real shock, on an average, when submitted to a vaginal hysterectomy than when operated upon by the abdominal route. The only rational explanation that can be forwarded to account for this fact is that the intestines and the peritoneum are not subjected to exposure to the air in the vaginal route, nor are they subjected to the handling which they are liable to receive in the abdominal operations. While in our improved methods, the abdominal contents are exposed and handled to a small degree compared to former times, at the same time we can not help but recognize that there is less shock after a perfect vaginal hysterectomy than after an abdominal hysterectomy in cases of like severity. A vaginal hysterectomy avoids the abdominal scar, which so many patients dread as a brand of mutilation which must be carried through life after all abdominal operations. Many patients I find have this wholesome dread to such a degree that there seems to be no comparison in their minds between the two operations. An abdominal operation contains all the horrors of a most dreaded affair, while a