

2. Two or three years later he was shearing at W—, and three of his fellow shearers contracted typhoid.

3. Three years later he was shearing at A—; the cook and several of the shearers contracted typhoid.

4. Two years ago he was shearing at L— when a fellow shearer contracted typhoid. (The diagnosis in this case I know to have been confirmed.)

5. His last association with the disease was at S— in the autumn of 1918, when he was engaged as a general farm servant. A rabbit, E., came to the farm shortly afterwards, occupied the same room, and shared his meals with A. M. E. was admitted to Dunedin Hospital suffering from typhoid fever in June, 1918 (agglutination and faeces positive), and it was while investigating this case that the inspector came across the carrier.

At the time of my interview A. M. seemed a hale, sturdy old man, and, but for his attack of typhoid fever in 1881, he had had no serious illness, and had always been remarkably well. No history of gall stones or gastrointestinal attacks could be elicited.

Laboratory Note.

Blood, urine, and faeces were first submitted for examination on July 9th, 1918, and subsequently at intervals, with the following results:

Agglutination Reactions (Dreyer's technique).—The patient's serum agglutinated his own bacillus up to 1 in 300, and agglutinated the standard (Oxford) strain of *B. typhosus* up to 1 in 250. The reactions were repeated on two occasions at intervals with similar results.

Urine.—No typhoid bacilli were found at any time by direct plating, plating after preliminary incubation, or by enrichment methods.

Faeces.—Very numerous typhoid colonies on MacConkey plates, and in almost pure culture, were found on July 9th, 1918. There were numerous typhoid colonies on July 18th; a few on August 2nd, 15th, and 29th. The colonies were numerous again on September 5th; there were a few on September 25th, and on October 24th they were once more numerous. Enrichment methods were unnecessary in the case of the faeces, as the bacilli were easily recovered by direct plating from preliminary emulsions. The technique followed was that outlined by Henderson Smith (BRITISH MEDICAL JOURNAL, July 3rd, 1915). The isolated bacilli agglutinated to titre with the typhoid serum of the Lister Institute.

A. M. was kept under observation in the isolation hospital for four months, during which time many of the recognized methods of treatment were tried, but without avail, as the faeces examinations indicate. He was meanwhile trained in habits of cleanliness, and, as he now fully realized his potentialities for danger to his fellows, he was discharged and instructed to report to the Public Health Department from time to time.

The Milroy Lectures

ON

HALF A CENTURY OF SMALL-POX AND VACCINATION.

DELIVERED BEFORE THE ROYAL COLLEGE OF
PHYSICIANS OF LONDON.

BY

JOHN C. McVAIL, M.D., LL.D.

VACCINATION AS IT WAS AND IS.

The Law.

NEITHER infantile nor re-vaccination has ever been compulsory on the population of the United Kingdom. The utmost penalty has been the infliction of fines, and non-payment of a fine has sometimes involved imprisonment, but the law has never allowed a child to be taken out of its mother's arms and forcibly vaccinated.

Various changes have taken place in law, practice, and doctrine since 1870. Vaccination was made obligatory in England in 1853. Boards of guardians were empowered to appoint vaccination officers in 1867; appointment of these officers was made compulsory in 1871. In 1898 domiciliary vaccination was to a great extent substituted for vaccination at public stations, and systematic asepticism in the operation was insisted on and arranged for. At the same time exemption on the ground of conscientious objection was enacted. The procedure for obtaining exemption was made easier in 1907. Public vaccinators and vaccination officers are under the Poor Law authorities, not under the health authorities, as obviously they

ought to be. The age for obligatory vaccination has been raised from three months to six months, as in Scotland.

In Scotland the obligatory law was passed in 1863, but the duties of public vaccinators were and are confined to defaulters who have omitted to secure the vaccination of their offspring before the age of 6 months. For the rest, vaccination is the concern of the private medical attendant and the child's parents, excepting for certain public vaccination stations where medical students are educated. Exemption since 1907 is obtainable even more easily than under the English Act.

Revaccination is entirely voluntary in both countries.

Decline in Practice.

Systematic practice of infantile vaccination has greatly diminished in recent years. At the same time that small-pox has become a much less prevalent and much less fatal disease than before, exemption from vaccination has been made very easily obtainable, and the Jennerian prophylaxis has largely fallen into disuse. The English Local Government Board's annual tabulation of vaccination returns has been discontinued during the war, so that the most recent statistics relate to the year 1912. At that time about one-half of the infants born and more than one-half of those surviving to the vaccination age were being vaccinated. No doubt vaccinations, in the absence of small-pox and under the easy system of exemption, have considerably diminished since then.

In Scotland in 1916 (the latest year for which figures are available) amongst the children surviving at six months—the statutory age for infantile vaccination—the percentage of unvaccinated was 41. This is a little less than the percentages for the two previous years, but much higher than the rate—6 per cent.—of the years before the Act of 1907, which facilitated the obtaining of exemption certificates.

The Doctrine.

The doctrine of vaccination has mainly altered in respect of, first, the need for revaccination, and, secondly, the value of recent vaccination when small-pox tends to become prevalent. Jenner's one serious error—that vaccination gave lifelong protection—resulted in this country being behind Germany in realizing the need for revaccination. But Marson,¹ giving his experiences of the London Small-pox Hospital, says, "I have always recommended revaccination after puberty," especially for persons indifferently or doubtfully vaccinated in infancy, or without any cicatrix remaining. Dr. Seaton declared in 1875:² "The revaccination of persons as they reach about 15 years of age should be as systematically done as is the vaccination of young infants," and he states that he laid down this rule some years previously. Opinion regarding the proper period of life for systematic revaccination has tended to change in the direction of an earlier repetition of the operation, adolescence in the original view having now been replaced by the age of 9 or 10 years, especially in presence of small-pox. Also, although it is generally recognized that, because it is done at an age when the process of bodily growth and development has been largely accomplished, revaccination efficiently performed yields a more prolonged protection than primary vaccination, yet when there is appreciable risk of small-pox infection the operation should again be repeated, especially if many years have passed. In the Local Government Board's Report for 1887 it is stated that "whether the protective influence of this second vaccination becomes impaired, and if so, under what conditions, is not known."

Germany.

This development of view as to the desirability under such circumstances of renewed revaccination will probably be strengthened when we become more acquainted with the facts as to small-pox in Germany during the war. It has always been known that under obligatory revaccination in that country such trivial amount of small-pox as occasionally did occur was to be found mainly on the frontiers, where Germany adjoins very incompletely vaccinated countries like Russia. Two or three million Russian prisoners interned in various parts of Germany have permeated that land to an unparalleled degree, and the risks of infection, which were formerly almost confined to the borders, have accordingly been extended right into the heart of the country. In 1917 in Berlin about 4,000

cases of small-pox occurred, with over 400 deaths. The strong vaccinal defences of modern Germany have, in short, been subject to more strenuous attack than ever before, and the protection which had been sufficient against occasional trivial invasions has been less able to resist the more prolonged and heavier onslaught. A German whose personal immunity had not been absolute was further protected by the generally high standard of immunity of the population, so that his chances of direct infection were few and rare. At the same time, it is reasonable to think that the privations of Germany in respect of the ordinary necessities of life—food and clothing and heating—taken together with the domestic and public anxieties of the war owing to deaths and disablements, have made the population to some degree more vulnerable to infectious disease. In Germany it should be noted that the male population fit for military service has, broadly speaking, the protection of a second revaccination on entering the army, while females and all males who for one reason or another were not drafted into the army have had only a single revaccination. It will probably be found that mainly in this section of the population has small-pox reasserted itself during the war.

In Germany, or at least in its civil population, forcible vaccination or revaccination has not been the law.³ The highest penalty is by fine or by imprisonment not exceeding three days, and, as ought to be the case in this country, vaccination and revaccination are on the same legislative footing. The German population, however, has been so drilled in ways of obedience that defiance of the law has been comparatively rare.

Calf Lymph.

In the practice of vaccination a most important change has taken place through the substitution of calf lymph for humanized lymph. The change resulted mainly from a desire to allay parental anxiety regarding the possibilities of conveyance of human disease by means of humanized lymph. This anxiety hardly existed in the medical profession, who freely vaccinated their own children from the arms of infants, the risk being so remote as to be considered practically negligible. The great virtue of calf lymph under present conditions is the facility with which, notwithstanding the time required for glycerination or other treatment, the supply can be multiplied at relatively short notice to meet the most extensive epidemic. It has been provided by the Local Government Board to all public vaccinators since the beginning of 1899. In 1871-73 and up to the period when calf lymph came into general use, it was extraordinarily difficult to obtain material sufficient for emergency revaccination called for owing to the existence of small-pox. Everything depended on the number of infants presented weekly for vaccination, and they might very readily be utterly insufficient for the purpose. This was so in Kilmarnock in 1873. In these circumstances many persons requiring and desiring to be vaccinated might remain unprotected, and there would even be temptation to resort to lymph taken from the vesicles of revaccination, a source which has never been regarded as satisfactory. In addition to the facility with which the supply of calf lymph can be increased it is now regularly kept in cold storage to the extent of half a million tubes by the Local Government Board. In the act of vaccination aseptic precautions are used to a very much greater extent than half a century ago.

Dosage.

One difference between practice in England and in Scotland is that in the former country the Local Government Board's standard of four vesicles with a total area of not less than half an inch is much more generally observed than in Scotland, excepting at the few vaccination stations. Certain statistics submitted to the Royal Commission on Vaccination rather seemed to indicate that the duration of protection conferred by infantile vaccination in Scotland was less than in England, and the explanation is not far to seek.

As regards the duration of protection afforded by different doses—at one time a matter on which bacteriologists tended to be sceptical—it is worth noting that all modern work on other vaccines has shown the primary importance of fixing a dose of bacilli at a standard rate, and that differences in the bacterial dose of the "vaccine" are every

day accepted without question as explaining the whole difference between protection by and complete failure of inoculations. Marson's famous statistics of the London Small-pox Hospital, supported as they were by Russell's striking diagram of Glasgow Hospital results, are consistent with modern bacteriology.

Vaccinal Condition of Population.

Besides what remains of systematic vaccination the present position with regard to the practice is, broadly speaking, that infantile vaccination and revaccination are resorted to in presence of small-pox.

Diminution in the vaccination of infants results in there being now a larger proportion of young adults who have not the protection against severity which vaccination in infancy would undoubtedly have given them, and have not the partial protection against attack which, in those well vaccinated in infancy, undoubtedly is maintained to a substantial degree in younger adult life. On the other hand, it has to be remembered that, in some places at least, the occurrence or threatening of small-pox has led to an amount of revaccination at different ages which in the mass is probably considerable, and that demobilization of the forces will add materially to the proportion of persons who have received protection in adult life. On the whole, however, one must regard the population as distinctly less protected than twenty years ago. Even at that time infantile vaccination was not, in the absence of revaccination, in any way a shield such as in normal times completely protected Germany. But it did interpose a very substantial—and in former years an indispensable—check on the spread of small-pox. If from this year onwards no vaccination whatever were done in this country, we should for many years have the benefit of protection hitherto obtained.

INFANTILE VACCINATION AND THE SPREAD OF SMALL-POX.

But in respect of infantile vaccination it is necessary to take notice of a contention which has been advanced as to the relationship of the practice to the spread of small-pox. The view in question was promulgated in 1893 by Dr. J. H. C. Dalton of Cambridge and has been adopted and developed by Dr. Killick Millard, Medical Officer of Health of Leicester,⁴ with all his characteristic energy and ability. The subtitle of Dr. Millard's book is "An Appeal for Reconsideration," and no one can have a better claim than he to make such an appeal. He has absolute faith in the protective power of recent vaccination against small-pox in the individual and has demonstrated his faith unequivocally in his work at Leicester. He took his own vaccinated children into the small-pox hospital, and had them photographed beside cases of the disease, using the photographs afterwards for persuasion of contacts to accept vaccination.

Briefly, he urges that to the public at large infantile vaccination is on balance disadvantageous because it often makes subsequent small-pox so mild as to be unrecognizable, with consequent spread of infection by missed cases. Therefore, he holds, the present law of so-called compulsory vaccination should be repealed. A subordinate reason submitted for this proposal is that repeal would diminish the opposition with which the offer of emergency vaccination in presence of small-pox is often met. That consideration is sound for what it is worth, but its value must be a matter of individual opinion, and need not be discussed here.

On the main contention, however, I desire to offer some observations. Though the Vaccination Acts are called compulsory they are so only in name, especially in recent years, and Dr. Millard agrees on that point. But legislation is a political question, and if infantile vaccination is a public danger there is no logic in confining its discouragement to the omission of legislative pressure. The discouragement should be active and definite. This would mean advice to a parent to refrain from vaccinating his child, the adviser hoping that if unfortunately the child subsequently took small-pox it should have so severe an attack as to make the disease easily recognizable, with a view to its immediate isolation and the protection of the public. A considerable proportion of such attacks would of course be fatal. The proposition raises a question in medical ethics. It would surely be wrong to refrain from

protecting one individual against severe or fatal small-pox in order that other individuals, adults or children, should escape the result of omission, by themselves or by their parents, to secure a safety which is open to all. But apart from ethics the view seems to me unsound that infantile vaccination is, on balance, disadvantageous in relation to the prevalence of and mortality from small-pox.

It may at once be agreed that infantile vaccination, by mitigating small-pox where it has failed to prevent it entirely, makes the disease much milder, with the result that on any large basis of fact more cases will be missed than if the attacks had been of ordinary severity. Indeed, modification as well as prevention of small-pox is one of the virtues of vaccination. But there is another side to the shield. It is true that an eruption of, say, ten pustules will more readily be overlooked than an eruption of 100 or 1,000 pustules. But the quantity of inherent infectivity is correspondingly less. Other things being equal, it is only one-tenth in the one case and one-hundredth in the other. The amount of buccal eruption, so far as it is important, corresponds broadly to the amount of cutaneous eruption. When a medical officer reports that certain cases of small-pox were so mild as to be unrecognized, he naturally thinks of this as increasing his difficulties, and is apt to forget the considerations on the other side. Severe small-pox is not by any means always recognized in its early stages, and a single "missed" case, say, in a vagrant, among a score or a hundred discovered cases may make all the difference in the spread of infection. Also, failure to notify small-pox has not always been due to non-recognition of the disease. In Dr. Spencer Low's report on the Dewsbury epidemic of 1904, he says that "non-notification of cases" in many instances meant "concealment of cases." It is clear that a mild concealed case would be much less likely to spread infection than a severe, unvaccinated concealed case.

Experiences of Medical Officers.

The epidemic of 1892-95, and in the provinces the epidemic of 1902-5, have been so mild in character that, independently of vaccination, the difficulty of diagnosis has been naturally much greater than ever before. Consequently references to missed cases bulk largely in the reports of medical officers, and Dr. Millard is able to cite numerous instances. But easy diagnosis can be obtained at too great a cost, and a locality is much better with its mild cases, whether naturally or artificially mild, and its more difficult diagnosis, than it would be with severe cases easily diagnosed but with a high fatality rate and producing a large amount of infectious material, however carefully guarded. If a missed case is naturally mild it will tend to cause the disease in modified form; if it is artificially mild it will tend to revert to the natural type of epidemic. If that type itself be mild the difficulty of diagnosis will correspond. If, on the other hand, it be severe, then the desired facility of diagnosis will be obtained, but at the cost possibly of a heavy attack with disfigurement, or even death, as a frequent result.

Bristol.—Sometimes a mild case does cause a considerable spread of infection. Dr. Davies records that in Bristol, in January, 1912, an "ambulant" case set agoing a series of small outbreaks which extended over eight months—4 cases in January, 18 in February, 8 in March, 12 in April, 7 in May, 15 in June, 7 in July, and 4 in August. As no death from small-pox occurred in Bristol during 1912 the type of disease throughout must have been mild, independently of vaccination. In 1903, however, 15 introductions by sea and land were checked at 46 cases, and in his report for 1905 Dr. Davies records how one mild case wandered about with the eruption well out, visiting a public-house where there were many workmen. Great efforts were made, with the aid of the Local Government Board, to watch for secondary cases, but only one certain and one doubtful case occurred. The disease had been since 1903 "of an extremely mild or minimal type which is possibly not highly infectious except to intimate, or bed-contacts," and which even in the unvaccinated may give merely a nominal attack. It appeared to have been imported from North America, and if the type remained unchanged, would be of as little importance as chicken-pox.

Derby and Halifax.—Dr. Howarth, in Derby, had in 1903-4 a total of 255 cases with 5 deaths, and states that

the mildness of type resulted in a number of cases being overlooked, and in addition instances of delayed notification were frequent. He goes on to remark that such cases add to the difficulties of repressing an epidemic, "but I must confess to some surprise at the fewness of cases which resulted from these causes," and he suggests that dissemination of infection may be less easy because of the vesicles forming hard cornified bodies, "and in addition the amount of infective material available for dispersion is probably directly proportionate to the amount of rash" (p. 29 of Report). Dr. Neech of Halifax, writing regarding a discrete case in his report of 1903, notes that the first batch of cases infected from it occurred amongst persons in the same workshop and in the same lodging-house. "No case at this time occurred among the general public, although he was moving freely among them."*

Dundee.—There was considerable prevalence of small-pox in Scotland in the years 1901-4 inclusive, in large centres of population, especially in the industrial belt which lies across the Lowlands from south-west to north-east. Within this belt the city of Dundee is a manufacturing and port town, with at that time about 163,000 inhabitants, with a good deal of poverty and slum population, and with thousands of married women working in the great jute mills, and leaving their children at home.

In Dundee in 1902 there were 57 notified cases of small-pox, with 4 deaths. In the course of his report Dr. Templeman, the medical officer, writes as follows:

In a considerable proportion of the cases the source of infection could not be traced. In a few it was ascertained that the person had been in contact with some one who was believed to have had a mild attack of chicken-pox, and in others to have suffered from influenza. I think there can be no doubt that during the whole course of the outbreak mild cases of small-pox were occurring which were not notified, either from the person not having sought medical advice, or from the case being diagnosed as influenza from the fact that no rash was discovered, or as chicken-pox from the mild character of the symptoms.

The only unrecognized case from which a considerable number of persons were infected was that of a man, 49 years of age, who had been suffering from an eruption for two or three weeks, but, as his general symptoms were trifling, the eruption was regarded as that of a common skin disease. Several of his fellow-workers had been visiting him during his illness, and two of them suffered from well marked small-pox, as did also his daughter (married) and his cousin, who resided in the country. It was rather a curious fact that although nine other persons resided in the house along with this man, none of them seem to have contracted the disease, except perhaps a lodger, who had a very slight illness, which, however, did not incapacitate him for work, and who had a few papules amongst his hair. One of his fellow-workmen afterwards contracted small-pox, and was probably infected by him.

In 1903, 36 cases were notified in Dundee. Dr. Templeman writes:

In a considerable number of instances the source of infection could not be traced, though it was in several cases found that the patient had been in contact with supposed cases of influenza or chicken-pox, these having really been cases of modified small-pox.

Notwithstanding such mild and unrecognized cases of small-pox, the disease obtained no large hold in Dundee. Throughout the five years 1900-4 the number of notified cases was 175, with 12 deaths, or 6.9 per cent. The disease was therefore of a fairly mild type, and difficult to diagnose. But infantile vaccination had been well attended to. Deducting "insusceptibles" and deaths before the age for vaccination, the percentage of unvaccinated survivors at six months of age was only 4.7. Whether this town would have profited in respect either of deaths or attacks, if infantile vaccination had been successfully discouraged in order to make diagnosis easy, is a question which hardly seems to require an answer.

Sydney and Trinidad.—In the remarkably mild Sydney epidemic of 1913 Dr. Armstrong calls attention to the low intensity of infectivity, and records that—

In the course of the epidemic twenty-seven country towns or districts of New South Wales were invaded by small-pox, and the total number of cases diagnosed in these localities only amounted to fifty-two. The greatest number of persons attacked in any one locality was six, and in sixteen localities only one person was attacked.

And of the Trinidad epidemic of 1903 Seheult says:

The slow spread of the epidemic was due to the slight infectivity of the disease. In many cases the contagion or virus seemed to require intimate contact for its transmission from

* Dr. Neech is of opinion that the disease is only slightly infectious until after the pustules have dried up and formed scabs.

one person to another, and even then it was remarkable how frequently instances were found in which such contacts escaped infection. (*Proceedings, Roy. Soc. Med.*, 1908, p. 236.)

Dunbartonshire and Stirlingshire.—My own experience of the risks of infection from small-pox so mild as to be hardly recognizable is that it is not very infectious. A case which greatly impressed me was that of a woman whose attack was discovered only through her having infected two persons within her own dwelling. She had been moving about freely in the town where she lived, shopping and meeting people on the streets. I feared an outbreak, but after hesitation it was decided to delay advertising a general offer of emergency vaccination, and to maintain vigilant watch for cases. Outside the woman's own dwelling not a single case occurred.

In my annual report for 1905 to the County Council of Stirlingshire I wrote as follows regarding a small-pox patient, Mrs. R. B., aged 35, of Stenhousemuir, the wife of a Carron Company's workman:

Her case is interesting with regard to the source of infection. The medical attendant informed me that, after the beginning of the year, the husband had had a slight illness, which was regarded as influenza, but that connected with it there had been one or two spots on the scalp. I interviewed the husband, and found that his illness had begun in Stenhousemuir, and had continued while he was temporarily employed in Bradford, and that he observed the spots on his scalp merely because they gave him trouble in combing his hair. I communicated with the medical officer of Bradford, and learned that he had been investigating an outbreak of small-pox which had occurred on January 30th, which he suspected to be due to a Scotsman from Carron Company, who had taken lodgings on January 16th, and had felt poorly, and thought he was suffering from influenza, but had no medical attention. He returned from Bradford on the 23rd, and his wife sickened on February 7th, or fifteen days afterwards, so there is no doubt she got the disease from her husband. This case illustrated a frequent experience. The man's attack was exceptionally mild, and he infected no one outside the house in which he lived, though he was in contact with many people outside. Dr. Evans, the Medical Officer of Health for Bradford, informs me that amongst a list of twelve contacts there, of whom seven were outside and five in the house where the man lodged, only two were attacked, these being among the latter five, while all the seven outsiders escaped.

The above passage is from a report on 19 cases in January and February, 1905, in East Stirlingshire. In the infected houses there were twenty-one children under 10 years old, but, owing to infantile vaccination, not one of these was attacked by small-pox. If, owing to discouragement of infantile vaccination, any of these twenty-one had not been vaccinated and had developed a severe or fatal attack, I wonder what the parents would or would not have said had it been explained to them that vaccination had been deliberately omitted in order that an attack, if it occurred, might be so severe as to be recognized, in the hope of getting the case away to hospital in time to prevent infection of the neighbours' children.

Leicester.—Dr. Millard himself, in discussing the control of "contacts," divides them into two classes—"inside," living in the same house with the patient; and "outside," living elsewhere, but "who have been in the same room with the patient after he has taken ill." For outsiders, he thinks vaccination scarcely worth while, but exercises surveillance. This practice, it will be borne in mind, was based on the experience of small-pox of a remarkably mild type, with a low fatality rate, so that many of the cases would be difficult of recognition even amongst the unvaccinated.

London.—The London statistics of 1892-95 and 1901-2 are worth examining in relation to the question at issue.

The earlier epidemic was of a mild type with a fatality rate of 8 per cent. The proportion of cases "unaccounted for" in respect of infantile vaccination had in the decade 1881-90 ranged between 5.7 and 13.9 per cent., the mean of the rates being 8.5. Public health organization was improving, but was not so well advanced as in 1901-2. The later epidemic was of a severe type, with high fatality—16.8 per cent. Public health organization was better developed, and the omission of infantile vaccination had increased greatly, so that default ranged from 16.4 to 33 per cent., the mean of the rates being 24.05. London, in fact, had made measurable progress towards the ideal of cessation of infantile vaccination. In these circumstances, with a more severe disease more easily diagnosed, with less of the infantile vaccination which is complained of as making diagnosis difficult, and with administrative organization improved by a decade of additional experience, the disease

in 1901-2 should, *ceteris paribus*, have been more effectively controlled than in 1892-95. But the facts were that in 1901-2 there occurred 9,659 cases, as compared with only 4,759 cases in 1892-95. London's huge population provides such a statistical basis as tends towards elimination of errors due to paucity of data, but even for London a careful survey of all relevant considerations would be necessary to justify actual conclusion, and so I content myself with calling attention to the facts set forth.

Another point to be noted is that, notwithstanding the superabundance of very mild small-pox in America and the constant traffic across the Atlantic (the journeys taking less than the incubation period), and the difficulty of diagnosis, no epidemic of the American type has been set up in this country since 1902-5.

Though in effect advocating the discouragement of infantile vaccination with a view to achieving such severity of attack as will make diagnosis easy, Dr. Millard himself aspires after mildness of type. "It is obviously," he says, "of the highest importance that the type of an epidemic should be kept as mild as possible." This is more than a pious aspiration. It suggests action to influence the type of a current epidemic. It is "to be kept" as mild as possible. But by what human effort except vaccination can such mildness be secured in an epidemic? In the Gloucester epidemic, of a naturally severe type, would not previous systematic infantile vaccination have had the effect of keeping the epidemic mild, of making the disease less fatal, and of altogether preventing hundreds of the attacks which did occur? One cannot both discourage vaccination in order to make the disease diagnosable and encourage it in order to keep an epidemic mild.

In thinking of this question of missed cases there is risk of being misled by false analogy. Every one knows that mild unrecognized scarlet fever often baffles the medical officer in endeavouring to control an outbreak. But the mildness of scarlet fever and its infectivity do not run parallel as in small-pox. Failure to recognize scarlet fever by parents, with consequent failure to send for a doctor, depends mainly on the absence of the rash, whilst infection, it is now accepted, comes mainly from the throat and nasal passages. The throat may be much affected, whilst the skin has little or no eruption. Also, Dr. Mervyn Gordon, reporting to the Local Government Board, maintains that infectivity depends on one organism, but severity of attack on another. There may therefore be no difference in infectivity as between a mild and a severe case of scarlet fever.* Another false analogy relates to the old practice of small-pox inoculation. It is alleged that thereby the individual was protected but that the community was endangered, and more harm than good was done. That proposition is historically open to dispute, and the Royal Commission on Vaccination wisely held the decision in doubt. But accepting it for the moment, variolation did produce an infectious disease, whilst vaccination does not. It is true, of course, that with lapse of time after vaccination immunity diminishes. The remedy, however, is not to refrain from infantile vaccination, but to resort to revaccination.

In 1904 Dr. Millard made the following reservation: "It is possible that if practically the whole population become unvaccinated, the 'Leicester Method' will prove insufficient to keep the disease in check." This is a hard saying. If vaccination makes small-pox so difficult to diagnose as to do more harm than good, surely a wholly unvaccinated population would be best of all for resistance of invasion. If only 20 per cent. are unvaccinated then the other 80 per cent. may, through missed cases, spread disease among the 20; if 40 per cent. are unvaccinated, they are liable to infection from the vaccinated 60; if 80 per cent. are unvaccinated there is still a danger from the 20 vaccinated. The fact is there is no half-way nor quarter-way house. If infantile vaccination does more harm than good, then the less there is of it the better, and none at all is best of all. Since writing these words I find that Dr. Millard's views on the disadvantage of infantile vaccination have forced him to practically the same conclusion. "I honestly believe that if the entire population of Leicester were either completely vaccinated (by repeated

* Dr. Millard, however, referring to scarlet fever, asks, "Is it not probable that the great change which has taken place in the type of the disease, in the direction of lessened severity, has been accompanied by shortening in the duration of infectivity?" (*Trans. Epidem. Soc.*, 1901-2.)

vaccination) or completely unvaccinated the danger of small-pox would be less."⁶

Here it is necessary to bear in mind what would be the effect on the condition of the community, as a whole, of the discontinuance of the infantile vaccination. Under exposure to small-pox the proportion of vaccinated persons infected is much less than of unvaccinated. The greater the total amount of vaccinal protection in a population the smaller is the number of persons liable to attack. For nine or ten years after infantile vaccination, especially if the prescribed standard of number and area of marks is adhered to, the individual enjoys a very large degree of immunity, not merely against death but against attack. In both respects the immunity continues, though in diminishing degree, for a much longer time than this, that against death being much more prolonged. The fatality rate of small-pox in childhood is exceptionally high. But it is childhood that is specially protected by infantile vaccination, and children allowed to remain unvaccinated in order that if attacked they might have an illness sufficiently severe to make diagnosis easy, would be more likely to have a fatal attack than if the disease were deferred to later years. This would be part of the price of easier diagnosis.

The object of vaccinal legislation is, of course, to promote vaccination. If it has no such effect then it is useless and ought to be given up, still more so if on balance it in some way or other tends to discourage vaccination. These are relevant considerations for the Legislature, which also has to take a broad view in relation to the whole doctrine of the liberty of the subject. But to discourage vaccination in order that the unvaccinated individual may have an easily diagnosable (therefore possibly fatal) attack of small-pox seems to me a proposition contrary alike to the principles of medical ethics and to the interests of the public health.

There is, however, one conceivable condition which would not only justify but demand the cessation of vaccination. If small-pox were to disappear, so also manifestly would the need for vaccination. The risks attaching to vaccination were never in this country more than trivial, and calf lymph with modern asepsis has made them imponderable in weighing the value of vaccination;* but if there were no need for vaccination it would have no value, and the marvellous decrease of small-pox since the close of the outbreak with which this century began makes such a possibility, however remote still, yet apparently less remote than ever before.

REFERENCES.

¹ *Med.-Chir. Trans.*, vol. xxxvi, p. 385. ² Local Government Board Medical Officer's Report, p. 97. ³ *BRITISH MEDICAL JOURNAL*, November 24th, 1894. ⁴ *The Vaccination Question* (H. K. Lewis, 1914), and *Public Health*, February and March, 1917. ⁵ *Public Health*, 1904, p. 620. ⁶ *Public Health*, March, 1917.

Memoranda:

MEDICAL, SURGICAL, OBSTETRICAL.

THE DURATION OF GESTATION AND THE RECKONING OF THE AGE OF A HUMAN EMBRYO.

In dealing with the questions of the duration of gestation and the reckoning of the age of a human embryo, we must bear clearly in mind (a) that no woman living and capable of living a marital life who has never menstruated, and who is incapable of menstruating, has ever or will ever become pregnant, and (b) that in ordinary circumstances menstruation is always held in abeyance during utero-gestation.

From time immemorial apparently it has been customary to reckon the duration of gestation and to estimate and fix the probable date of delivery from the time of occurrence of the last menstruation. It has been assumed, on no scientific grounds, that gestation in woman extends over a period of ten lunar months or 280 days, but strange to say, although fertilization cannot take place during menstruation, some authorities nevertheless consider that the 280 days should be calculated not from the cessation

*The Royal Commission reported that the risks "though undoubtedly real and not inconsiderable in gross amount," still "when considered in relation to the extent of vaccination work done, they are insignificant." Since the Commission reported, the change from humanized to glycerinated calf lymph has been complete.

but from the time of appearance of the last menstrual discharge. Because, however, when an ovum is fertilized, gestation begins at a definite time the method of reckoning the probable date of parturition from the last menstrual period has met with a certain amount of success and satisfaction owing largely to the fact that a large percentage of women menstruate every twenty-four or twenty-eight days. In those cases in which menstruation is wont to recur every five or six weeks the present method of reckoning the probable date of delivery is apt to bring discredit upon medicine as a science. It is, moreover, generally conceded that fertilization may take place at any time during the intermenstrual resting period—the period, that is, extending from the cessation of menstruation to the two or possibly three days prior to an expected menstruation, when there is, in anticipation of the heightened oxidative processes necessary for the fulfilment of that function, an increased determination of blood to the internal organs of generation. I have¹ elsewhere drawn attention to the fact that we have the strongest clinical reasons for believing that no matter when the human ovum is fertilized gestation in every case begins during the two or possibly three days preceding an expected menstruation. Let us, however, assume that fertilization and the starting of gestation are to all intents and purposes synchronous, or rather that the beginning of gestation follows fertilization immediately, then it must be allowed that the gestation period for an ovum fertilized immediately after menstruation is longer than that for an ovum fertilized four or five days before an expected menstruation. In support of this contention we have no scientific or clinical fact. From what obtains in the matter of the germination of seeds and the incubation of birds' eggs, we are justified in concluding that even in the case of the fertilized human ovum fertilization and the beginning of gestation are not necessarily synchronous except where fertilization happens when the internal organs of generation are about to prepare for an anticipated menstruation.

Embryologists have hitherto adopted the aforesaid fallacious method of estimating the age of any given human embryo. Some are inclined to attach much importance to the probable date of fertilization, but from what I have already stated it must be evident that, even if we could rely upon the statements of women as to the occurrence of an alleged fruitful and possibly single act of coitus, the date of such would be of no service in estimating the probable age of a human embryo. It is quite clear that our present method of reckoning the duration of gestation is a tacit admission either that fertilization and the commencement of gestation are synchronous, and take place at a definite and fixed time in the case of every fecundated woman, or that, whilst fertilization may take place at any time during the intermenstrual resting period, gestation itself begins in all cases at a definite and fixed time. That the latter is the correct interpretation of all the clinical facts connected with the reproductive process in women I have no shadow of a doubt.

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COLLOSOL ARGENTUM IN A MENINGOCOCCUS CARRIER.

Nurse — had been nursing a case of cerebro-spinal meningitis and became infected. Swabs taken at weekly intervals from the nasopharynx by Captain Assinder, Pathologist 2/1st Southern General Hospital, showed meningococcus on culture. The swabs continued to be positive each week from October 28th, 1918, to January 1st, 1919. The patient was isolated and subjected to various forms of treatment, including Levick steam inhalations, chloramine-T sprays, etc., but the meningococcus remained present. She became very melancholic and despondent owing to the segregation and the lack of success in exterminating the germ. She was referred to me for suggestions as regards any intranasal treatment, and as a last resource I suggested a spray of collosol argentum. From January 3rd this was applied four times daily for three minutes, in an all-glass spray, through both nostrils. At the expiration of the first week no meningococci were found in the test swab. The same result was obtained at the end of the second and third weeks, the

¹ *New York Medical Journal*, January 16th, 1917.