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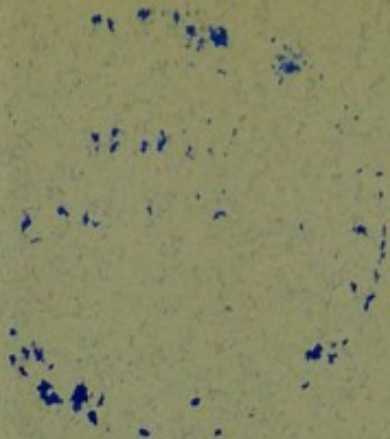
BY

JOHN C. McVAIL, M.D., D.P.H.

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VACCINATION OR SANITATION?

BY

JOHN C. McVAIL, M.D., D.P.H.

It is one of the commonest allegations of those who assert that vaccination is not a preventive of small-pox, that diminution of small-pox prevalence attributed to vaccination, is wholly or largely due to sanitation. It is argued that as certain other infectious diseases have also diminished, and that as their diminution is acknowledged to be due to sanitation, the diminution in small-pox should be similarly attributed. In this line of argument no cognisance is taken of the fact, that for one infectious disease sanitation means one thing, and for another infectious disease another thing. For example, the preventive measures which have had most influence against typhoid fever, are not those which have been most powerful against typhus, and the causes which have made cholera almost unknown among us, have had no similar influence on whooping cough; nor are diarrhoea, and rabies, and erysipelas, and anthrax, and diphtheria to be dealt with by identical sanitary procedures. As regards small-pox, neither drainage, nor water supply, nor increased air space, nor improved cleanliness, can account for the remarkable changes which have taken place in the age incidence of the disease, can explain the fact that small-pox was formerly a disease of infancy, but that now-a-days it has been transferred to more advanced periods of life; to periods of life at

which some preventive cause operative among infants and juveniles, would appear to have lost much of its power. It is obvious that neither sanitation as a whole, nor any of the individual measures above noted can account for this remarkable phenomenon. Fresh air, and good drainage, and good water, and general cleanliness are healthful, not only for children, but for adults.

In addition, however, to such obvious considerations as these, it may be well to call attention to what may be looked on as an experiment carried out on a huge scale to test the effect of vaccination on small-pox, in the absence of sanitation. The City of Glasgow, at the beginning of the present century furnishes the facts. Those relating to the influence of vaccination on small-pox were put on record by Dr. Robert Watt, of Glasgow, in 1813, and those relating to the sanitary condition of the City in the early part of the century are to be found most conveniently in Dr. Russell's recent monograph on the sanitary history of Glasgow. The population of Glasgow increased very rapidly from about the year 1780 onwards. In that year it was 42,832; in 1791 it was 66,578. In 1801 it had increased to 83,000; in 1811 to 110,000; in 1821 to 147,000; in 1831 to 202,000, and so on. The area occupied by these populations was very small, the people living layer upon layer in high tenement houses closely built together. The date of the earliest description of the sanitary condition of the City given in Dr. Russell's work is 1818, and the author of the description is Dr. Robert Graham, then Professor of Botany in the University. Here is part of his Report:—

If any man wonders at the prevalence of continued fever among the lower classes in Glasgow, or at its spreading from their habitations, let him take a walk which I did to-day with Mr. Angus, one of the district surgeons. Let him pick his steps among every species of disgusting filth, through a long alley from four to five feet wide, flanked by houses five

floors high, with here and there an opening for a pool of water, from which there is no drain, and in which all the nuisances of the neighbourhood are deposited in endless succession, to float and putrefy and waste away in noxious gases. Let him look as he goes along into the cellars which open into this lane, and he will probably find lodged in alternate habitations, which are no way distinguished in their exterior, and very little by the furniture which is within them, pigs, cows, and human beings, which can scarcely be recognised till brought to the light or till the eyes of the visitant get accustomed to the smoke and gloom of the cellar in which they live. I have been to-day in several dens of this kind, where I did not see persons lying on the floor near me till Mr. Angus, whom a previous visit had taught where to find them, inquired after their health. I was in one closet, measuring twelve feet by less than five, on the floor of which he told me six persons had lain, affected with fever, within these two days, and where I saw the seventh inhabitant now confined. We found in one lodging-house, fifteen feet long by nine feet from the front of the beds to the opposite wall, that fifteen persons were sometimes accommodated; and when we expressed horror at the situation in which they were placed, the woman of the house, somewhat offended and, I believe, a little alarmed lest we should cause some enquiry to be made by the police, said, in support of the character of her establishment, that *each family* was provided with a *bed*, and that she very seldom had anybody lying on the floor. I shall only mention one other instance of misery. In a lodging-house, consisting of two rooms, separated by boards, the first thirteen feet by eleven, the other fifteen by eight, twenty-three of the lowest class of Irish were lately lodged. To-day, there are fourteen, of whom two are confined with fever, three are convalescent, and one only has hitherto escaped. There are only three beds in this house (denominated—with that facetiousness which enables an Irishman to joke with his own misery—flea barracks), one of them in a press half-way up the wall, the others wooden frames, on which are laid some shavings of wood, scantily covered with dirty rags. Most of the patients were lying on the floor. A man, two sons, and an adult daughter were lying side by side on the floor of the first room, their bedding of the same materials with the others, and the boys being destitute of shirts. Could imagination feign a combination of circumstances more horribly conducive to disease and immorality?

Nineteen years later (in 1837), there is a report on the same subject by Dr. Cowan, Professor of

Medical Jurisprudence in the University. He writes thus :—

Many of the causes of the production and propagation of fever must be ascribed to the habits of our population ; to the total want of cleanliness among the lower orders of the community ; to the absence of ventilation in the more densely peopled districts ; and to the accumulation, for weeks and months together, of filth of every description in our public and private dunghills ; to the over-crowded state of the lodging-houses resorted to by the lowest classes ; and to many other circumstances unnecessary to mention.

In the following year, Mr. Symons, Assistant Commissioner on the condition of Handloom Weavers, wrote as follows :—

These districts (the low districts of Glasgow) contain a motley population, consisting in almost all the lower branches of occupation, but chiefly of a community whose sole means of subsistence consists in plunder and prostitution. Under the escort of that vigilant officer, Captain Miller, the Superintendent of the Glasgow Police, I have four times visited these districts, once in the morning and three times at night ; I have seen human degradation in some of its worst phases, both in England and abroad, but I can advisedly say, that I did not believe, until I visited the wynds of Glasgow, that so large an amount of filth, crime, misery and disease existed on one spot in any civilised country. The wynds consist of long lanes, so narrow that a cart could with difficulty pass along them ; out of these open the "closes," which are courts about fifteen or twenty feet square, round which the houses, mostly of three storeys high, are built ; the centre of the court is the dunghill, which probably is the most lucrative part of the estate to the laird in most instances, and which it would consequently be esteemed an invasion of the rights of property to remove In the lower lodging-houses, ten, twelve, and sometimes twenty persons, of both sexes and all ages, sleep promiscuously on the floor in different degrees of nakedness. These places are generally, as regards dirt, damp, and decay, such as no person of common humanity would stable his horse in. . . . I visited the parts of Edinburgh likewise, where the lowest portion of the community reside, but nothing which can for a moment be compared with the wynds of Glasgow exists there. It is my firm belief that penury, dirt, misery, drunkenness, disease, and crime culminate in Glasgow to a pitch unparalleled in Great Britain.

Two years later Dr. Neil Arnott reported to the Poor Law Commissioners some of the results of an inspection which he made along with Mr. Chadwick and others :—

In a perambulation on the morning of September 24th, with Mr. Chadwick, Dr. Alison, Dr. Cowan (since deceased, who has laboured so meritoriously to alleviate the misery of the poor in Glasgow), the police Magistrate, and others, we examined these wynds, and, to give an idea of the whole vicinity, I may state as follows :—

We entered a dirty low passage like a house door, which led from the street through the first house to a square court immediately behind, which court, with the exception of a narrow court around it leading to another passage through a second house, was occupied entirely as a dung receptacle of the most disgusting kind. Beyond this court, the second passage led to a second square court, occupied in the same way by its dunghill; and from this court there was yet a third passage leading to a third court and third dungheap. There were no privies or drains there and the dungheaps received all filth which the swarm of wretched inhabitants could give; and we learned that a considerable part of the rent of the houses was paid by the produce of the dungheaps. Thus, worse off than wild animals, many of which withdraw to a distance and conceal their ordure, the dwellers of these courts had converted their shame into a kind of money by which their lodging was to be paid. The interiors of these houses and their inmates correspond with the exteriors.

In 1842 Mr. Chadwick himself wrote :—

It might admit of dispute, but, on the whole, it appeared to us that both the structural arrangements and the condition of the population of Glasgow was the worst of any we had seen in any part of Great Britain.

It is evident from these quotations that we are here dealing with a population in which sanitation was simply unknown; a population, moreover, whose health conditions appear to have been steadily going from bad to worse, owing to the rapid growth of the city. When we inquire as to the prevalence of small-pox in Glasgow previous to the introduction of vacci-

nation, it is not surprising to find that the record is a remarkably bad one. Of every 100 deaths from all causes, about 19 were due to small-pox. The actual figures from 1783 to 1800 inclusive are:— Total deaths from all causes, 31,088; and from small-pox, 5,958. During the same period the total deaths from measles were 433, from whooping-cough 1,553, and from “stopping” or croup (which may have included an unknown amount of diphtheria) 871. The time whose statistics are dealt with by Dr. Watt begins with 1783, and ends with 1812—thirty years in all. For convenience, he divides the thirty years into five periods of six years each, and gives, on the opposite page, a tabular synopsis of percentages of all-cause deaths caused by certain diseases.

It would have been very useful had rates per million been able to be stated, but there are the usual difficulties in the way. The deaths were taken from the churchyard registers, and only three of five registers were available for the earliest years. The period (thirty years) dealt with by Dr. Watts begins in 1783, but one of the registers begins in 1787, and another so late as 1807. While, therefore, the relative proportions of deaths contributed to the total deaths by easily distinguishable diseases are quite reliable, rates to population would be untrustworthy. As to the four diseases, small-pox, measles, chincough, and stopping, Dr. Watt writes:—

These are so distinct from one another, and so different from every other disease, that I think their numbers must be very correct.

It will be observed that the deaths under ten years old were considerably more than the deaths at all other ages combined. During the thirty years the heterogeneous group of

Periods.	Small-Pox.	Measles.	Chin-cough.	Stopping.	W. in Head.	Teething.	Bowel-hives.	Still-born.	Fevers.	Under Two.	Under Five.	Under Ten.	Total Under Ten.	Total Deaths in the Registers.
I.	19.55	.93	4.51	2.54	.74	4	6.72	5.03	12.65	39.40	10.66	3.42	53.48	9,994
II.	18.22	1.17	5.13	3.33	1.73	4.12	6.43	5.53	8.43	42.38	11.90	3.79	58.07	11,103
III.	18.70	2.10	5.36	2.47	2.14	2.41	6.47	6.33	8.24	38.82	12.21	3.45	54.48	9,991
IV.	8.90	3.92	6.12	4.93	2.11	2.11	7.27	6.69	9.87	38.50	13.43	5.10	52.03	10,034
V.	3.90	10.76	5.57	5.18	2.45	2.45	9.26	6.70	6.49	35.89	14.22	5.58	55.69	13,354

diseases known as "fevers" showed considerable irregularity in the death registers, with, however, a tendency to improvement; but not much weight can be given to this fact, owing to the general indefiniteness and changeability of the nomenclature. Whooping-cough increased, though not very greatly. In "stopping" there was a considerable increase, the percentage contributed to the total deaths for the five successive periods being 2.54, 3.33, 2.47, 4.93, and 5.18. In measles, which of course was well known and well defined, there was a very remarkable increase. In the first of the five periods, namely from 1783 to 1788 inclusive, measles contributed less than 1 per cent. (0.93 per cent.) to the total deaths. In the next period its contribution was 1.17, in the next 2.10, in the next 3.92, and in the last (from 1807 to 1812 inclusive) no less than 10.76.

It was into this City of Glasgow, with overcrowding on the increase, with these diseases of children on the increase, and with conditions of life, which from 1818 onwards have been described as above quoted, that vaccination was introduced. The new prophylaxis was very largely taken advantage of. While it is impossible to give accurate figures of the numbers vaccinated, Dr. Watt notes as to his five periods, that, "The first three of these periods had passed before the vaccine inoculation could have had any influence," but in the fourth period, he says: "It had nearly reached its maximum;" that is, of course, the maximum of the thirty years; while as to the last period, he writes: "It may be said to have been pretty fully established, perhaps as much so as in any other city in the Empire." This appears to be no exaggerated statement, for at the time when he began the investigation which led to the publication of his book in 1813, "above 15,000 had been inoculated

publicly at the Faculty Hall, and perhaps twice or thrice that number in private practice." This gives a total of perhaps fifty or sixty thousand vaccinations at a time when the population might be about 110,000; and when we consider the very extensive prevalence of small-pox in Glasgow in the last part of the eighteenth century, and the fact that only those who had not had small-pox would be vaccinated, we are forced to the conclusion that though these fifty or sixty thousand vaccinations must have been spread over several years, and some proportion of the vaccinated must have died from general causes, yet the total of the vaccinated population in Glasgow must have been very considerable, relatively to the population which had neither had small-pox nor been vaccinated.

In these circumstances, how was small-pox affected? Under the prevailing insanitary conditions, did it increase slightly like whooping-cough, or considerably like "stopping," or enormously like measles? Not so. As has been said, in the first three periods, from 1783 to 1800 inclusive, small-pox contributed about nineteen to every hundred deaths from all causes. The figures for these three periods are very nearly alike: 19.55 for the first, 18.22 for the second, and 18.70 for the third. In the fourth period, from 1801 to 1806, the rate fell suddenly to less than one-half of its previous average, the contribution being only 8.90. In the fifth period it again fell to less than one-half of its rate in the fourth period—to 3.90 per cent. of all deaths. For every nineteen deaths contributed by small-pox to the total mortality previous to the introduction of vaccination, only four deaths were contributed a few years after the practice had come into vogue. It is with this fifth period that Watt brings his figures to a conclusion. Thus while insanitation was hurrying on from bad to worse, till the startling conditions described for 1818 and

later years were being approached, and while other infectious diseases of infancy were on the increase, small-pox was diminishing by leaps and bounds.

It is not to be supposed that these statistics were compiled by a man who was particularly friendly to vaccination. On the contrary, the purpose of the monograph is to suggest that the increase in measles must have been indirectly due to vaccination. Knowing all the local circumstances, and relying not merely on statistics, but on "the experience of thirteen years' pretty extensive practice," Watt accepts it as beyond question that vaccination was the cause which had prevented small-pox; but looking to the great increase in measles, he concludes that small-pox itself must have been a preventive of measles, and that the small death-rate from measles, prior to the introduction of vaccination, must have been due to small-pox attack as a protection against measles. It is obvious that Watt was right to this extent, that the prevention of thousands of deaths from small-pox would leave the children so preserved alive to be open to attack by measles. My purpose here, however, is not to discuss any theory of substitution of measles for small-pox, following on the prevention of small-pox by vaccination or any other means, but to stick to the one question—as to whether, in the utter absence of sanitation, small-pox went down before vaccination.

From beginning to end of Watt's pamphlet, there is no indication that he recognised the increasing overcrowding and filth of Glasgow as having any part in the increasing prevalence of the infectious diseases of children, other than small-pox. Dr. Watt's enquiry regarding small-pox was published merely as an appendix to a treatise on whooping-cough; and in his "Sanitary History of Glasgow" Dr. Russell notes how curiously blind even so able a man as Watt was with regard to the place and

power of infection. Dr. Russell writes thus:—
 “Perhaps the fact of greatest present-day interest in the 330 pages of Dr. Watt’s treatise on chin-cough, is recorded in the history of the case of his little boy, aged six. About the middle of December he showed ‘symptoms of a common cold.’ By Christmas ‘it appeared pretty obvious that he had got the chin-cough. By the New Year this was certain.’ The ‘kinks’ were fully formed, and generally ended in vomiting.” Dr. Watt proceeds:—
 “We were now disposed to take him from school, but from a fear of being left behind by his companions, he was exceedingly averse to the measure, and therefore *continued to attend regularly* till Friday, January 8th.” He was then so much worse that he “consented to leave off going to school until he was better,” which, poor boy, he was never destined to be. He died on the following Thursday. This is very characteristic of the sort of paralysis of mental assimilation with reference to infectivity, which now seems to us unaccountable, but which was until comparatively recent times manifest in many ways. Even in Dr. Watt’s mind, the belief that whooping-cough is infectious “lay inert like a stone in the earth, barren of practical suggestion.”

This brings us face to face with what we may assume to be about the only question which could be raised by the *advocatus diaboli* regarding vaccination as the cause of the small-pox diminution in Glasgow. It is alleged by some writers that the practice of small-pox inoculation which preceded vaccination, did more to spread the disease than to prevent it, as, though it protected the individuals operated on, they infected others. Other writers, of whom may be mentioned Gregory of the London Small-pox Hospital (a predecessor of Marson) and the late Dr. Guy, urged the opposite view, namely, that small-pox inoculation had greatly diminished

the prevalence of the disease. I have been inclined myself to look on the question as still in doubt, and in 1887 when I first wrote on this particular point, I indicated that view. Since then, however, I have consulted the earlier volumes of Sir John Sinclair's Statistical Account of Scotland, and the evidence there given is certainly very strongly in favour of the opinion that the practice of variolous inoculation lessened small-pox prevalence. The Statistical Account is contained in a large series of volumes published between the years 1791 and 1799. It consists of records of every parish, contributed chiefly by the parish ministers. Many of the contributors did not seem to think that the question of public health was embraced in the reference to them by the compiler, and have not a word to say on the whole subject, confining themselves to matters of trade, agriculture, rents, population, &c. Many others, however, refer to the health of the inhabitants. Scarcely anyone does so without referring to the ravages of small-pox, and nearly all who speak of small-pox speak of it as having been greatly diminished by the spread of inoculation. Regarding Stranraer it is recorded that "The progress and ravages of small-pox have been much checked by inoculation, which is frequently practised both in the town and in the country." At Mid and South Yell, in Shetland, one of two causes given for considerable increase of population is "the amazing success with which inoculation has been attended. Formerly the small-pox occasioned the most dreadful ravages in these islands, frequently carrying off a fifth part of the inhabitants. Now hardly any suffer by this disorder." Similarly, at Duirinish, in Skye, increase of population is attributed to inoculation. At Logierait, in Perthshire, "since the practice of inoculation has been introduced amongst us we suffer much less than formerly from the small-pox.

At Old Kilpatrick, in Dumbartonshire, "inoculation is now generally practised in the parish, which is a happy circumstance, both on account of the population and the difference it makes in the look of the people." Such quotations could be multiplied indefinitely.

Returning to the question as it affects Glasgow, I find that in 1765 Dr. Alexander Monro, *primus* of Edinburgh (the first of three well-known professors of that name in the medical faculty of the University), records that 956 inoculations had then been performed in the city, and no doubt the practice afterwards prevailed there as elsewhere. But as regards our present argument, it matters little whether inoculation increased or diminished the small-pox mortality of Glasgow, or what effect on the possibilities of small-pox infection might be theoretically attributed to such decrease in the practice of inoculation as very probably followed on the introduction of vaccination. For, independently of inoculation, there was, even after the introduction of vaccination, and all through the period dealt with by Watt, abundant opportunity for infection of every person in the city who remained susceptible to the disease. While vaccination, in proportion as it was practised, lessened small-pox, it was not universally practised, and did not abolish small-pox. Beginning with the year 1801—the first year of Dr. Watt's fourth period, when vaccination was not long commenced—the following are the numbers of the annual *deaths* from small-pox up to and including the year 1812, with which Dr. Watt's fifth period comes to an end:—245, 156, 194, 213, 56, 28, 97, 51, 159, 28, 109, 78. The total is 1,414. These are deaths. It is a favourite assertion of opponents of vaccination that in the last century the small-pox fatality was only 18 per cent. of the cases. This rate would give a total of 7,855 cases, but we may take off a very

large discount from this calculation, without leaving any doubt as to the plentiful opportunity that there was of catching small-pox in Glasgow. Supposing that the cases were 6,000 in the twelve years, then we have an average of 500 fresh sources of infection every year, the average duration of infectivity of each individual being at least three or four weeks. Further there was all the infected bedding and clothing, in the filthy houses, five flats high, in the narrow wynds and closes of the city. For we must recollect that even in the mind of Watt, "lecturer on the theory and practice of medicine," the belief in infection "lay inert like a stone in the earth, barren of practical suggestion." In the utter absence of isolation and disinfection, and in presence of such conditions as existed in Glasgow, there can be no doubt whatever that all who were susceptible of small-pox got small-pox. Of course, after vaccination came into use the cases of small-pox were vastly fewer than before. But the amount of infective material in existence in Glasgow in the last century was superabundantly great—there was enough for the whole of Europe if only it had been reasonably distributed—and even after vaccination had protected the vaccinated, the hundreds of cases still occurring among the unprotected were far more than enough to give small-pox to everybody in the city who could take small-pox. Small-pox in Glasgow was like a bounteous pear tree which, in the exuberance of its fertility, casts off and scatters around, all but a fraction of its blossoms, and yet has enough left to overload its branches in due season with ripened fruit.

We have seen that in Glasgow, previous to the adoption of vaccination, nearly one-fifth of all deaths were due to variola. A moment's consideration will show that this practically means that every person who survived till five or seven or ten years of age got small-pox. Let us suppose a place

with a population of 50,000 and a birth-rate and also a death-rate of 30 per 1,000. Then we have annually 1,500 births and 1,500 deaths. If of the 1,500 deaths one-fifth are from small-pox, we have 300 small-pox deaths. With a fatality of 25 per cent. these 300 deaths mean 1,200 cases. With 1,500 births per annum and 1,200 cases of small-pox per annum we have a balance of 300 persons born per annum who either die before catching small-pox or are insusceptible to the disease. Of course, these figures are quite hypothetical, and I use them merely in general illustration of the proposition that when small-pox is for any long period of time responsible for one death in every five in a given community the disease is, in its attacks, almost universal; and I think I have shown that the difference in the small-pox death-rate of Glasgow, before and after the introduction of vaccination, simply represented the amount of vaccination practised in the city. Vaccination was a *vera causa* and the only *vera causa* of the diminution of small-pox. The disease still continued to attack all who were susceptible to it, and to kill its full proportion of them. In the years treated of by Dr. Watt all vaccinations were *recent* vaccinations. There had been no time between 1801 and 1812 for any but a small part of the earliest of the operations to lose any of their protective power. Therefore, the question of the need for revaccination does not come into view here. Had Watt written another pamphlet twenty or thirty years later he would have found a different problem to solve. By that time he would have begun to recognise that insanitation, in its particular details of filth, overcrowding, bad ventilation, etc., was responsible for increase of infectious diseases, and that small-pox was not a preventive of measles. But he would have had to ask himself how it was that small-pox, which formerly attacked almost

everyone in childhood, was now beginning to seize on some of the adults who had been protected in infancy by the operations at the Faculty Hall and elsewhere.

For us, however, at this centenary of Jenner's first vaccination, the lesson of greatest interest is, that in spite of insanitary conditions which are hardly conceivable now-a-days, the Jennerian prophylactic had the same power to protect against small-pox that it has been shown to possess under all other varying circumstances and conditions, even in the case of those whose lives at the present time are spent in the wards of small-pox hospitals, in an atmosphere possibly still more abounding in the poison of the disease than were even the most crowded parts of Glasgow during small-pox epidemics a hundred years ago.



