

## REFLEXIONS SUR LES AVANTAGES DE L'INOCULATION

MR. DANIEL BERNOULLI  
DOCTOR OF MEDICINE, PROFESSOR OF PHYSICS AT THE UNIVERSITY OF BASEL,  
ASSOCIATED FOREIGNER OF THE ACADEMIE DES SCIENCES

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Of all those who have treated this matter, it is without contradiction *Mr. de la Condamine*<sup>1</sup> who has done with most success. He is already seen at end to persuade the better part of the reasonable world of the great utility of inoculation: as for the others, it would appear useless to wish to employ reason with them; since they do not act by principles. It is necessary to lead them as infants toward their betters: it is the sole custom which can offer them a ministering hand. Inoculation would be shortly adopted in Europe, if the political good wished to be associated with humanity: I say even with Christian charity; & I call to those who by a more ardent that illuminating zeal treat this method as criminal. Will they not agree that God demands the conservation & propagation of the species which he has created in his image? There remains only to prove to them that the most certain & most efficacious way to fulfill these views, is without inoculation contradicted. But in vain this truth will be recognized by those who will have meditated; in vain even some particulars will collect the benefit. It will be lost for the State as long as the multitude will not be convinced. It can be only by the experiences multiplied & done in large: in a word by the public establishment in some hospital such as the one of the orphans where one would inoculate all those who would not give the contrary indication. In consequence of a similar establishment, I do not doubt that the practice of inoculation became common in France before ten years passed; provided that one published each year in the registers authenticated & in good order. Beyond the consoling satisfaction to know the life each year in a great number of subjects, one would have again the advantage to perfect soon the method to the point of making it with an entire certainty; if it is true every time that there is some risk. I make this restriction, because the observations do not establish this risk well. The mortality lists prove that of 20000 infants of 4 years there die around 700 of them in the course of a year, or around 60 per month.<sup>2</sup> If therefore one gives on month to the course of the malady caused by inoculation, one will have sixty infants at least out of the 20000 who will die probably in this term independently of the effect of the operation; that is to say 1 out of 133. If one would wish to restrict the critical time of the insertion to 15 days, it would be again 1 out of 661, a number which differs little from 1 out of 593, or the one of

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Translated by Richard J. Pulskamp, Department of Mathematics and Computer Science, Xavier University, Cincinnati OH.

<sup>1</sup>“Memoire sur l’inoculation de la petite verole,” *Mém. Paris* 1754, pp. 615-670, and “Second Mémoire sur l’inoculation de la petite verole, contenant la suite de l’Histoire de cette méthode et des ses progrès, de 1754 à 1758,” *Mém. Paris* 1758, pp. 439-482.

<sup>2</sup>Mr. Bernoulli serve himself of the lists of Breslau, where there die many fewer infants than from elsewhere. If he had employed the lists of London, or even those of Paris, the proportion that he had found would be much more advantageous to inoculation. (Note of the editor of the *Mercure de France*.)

the deaths in London in the hospital of the inoculated at each age during the course of four years according to the printed list, published by the administrators. It is true that each age demands a different evaluation: however these results show rather clearly that it is not yet well established that one incurs some risk be it of so little importance by being made inoculated, since it is not yet demonstrated that the number of those who die during the critical times of the insertion, surpasses the number of those who would die in the same term, if they had not been inoculated at all. It is therefore yet permitted to suppose that inoculation is not accompanied by any risk, provided that it is well administered. By which scruple could one therefore be refused by means of putting this truth into the greatest evidence, such as a sequence of authorized experiences, & of which the results would be rendered public?

The only inconvenience that I can foresee in the establishment that I propose, it would be perhaps to see diminish by the fear of the event the number of children who one would carry the first year to the hospital of the orphans.<sup>3</sup> Is this good or bad? Although it may be, the second year, or at the latest the third would postpone the things at the old rate. After one such experience is there a father of the family who did not follow an authorized example by a public institution? The notoriety of the success would make soon be silent the prejudiced timids, in order to hear more only the voice of paternal love & of charity. The other nations would be infallibly driven by the example of the most enlightened nation, & with time a practice so beneficial to the good of humanity would become universal.<sup>4</sup>

It would not be impossible after this that the malady attacked in its principle changed in nature in the second or third generation, that it lost all its poison, or that it ceased of itself. If we knew many marriages between inoculated persons & the lot of their infants, we could pronounce on this question definitely.

The two great motives for inoculation are humanity & the interest of the State. Humanity wishes that one assure & that one conserve life in each particular, either young, or old: the interest of the state demands the population of the Realm. The increase of the number of subjects would produce in the revenues of the King an increase that one can evaluate at around 20 livres per head each year, by supposing the number of the inhabitants of 18 million & the revenues of the King of 360 million. I will not be attached to the identity of the proportion; but when one would reduce it to the half, the profit would not permit becoming immense with the times: besides the increase of the revenues is not, nearly for the state, the only advantage that it is necessary to consider in the present case.

Another important consideration, is that each girl until the age of 16 or 18 years, is in herself, not only useless, but entirely in the charge of society: she contributes nothing, or very little to the needs of the public. To consider only the interest of society, it would be worth more for her that each of those who are destined to die before the age of 16 years were never born. By losing a child before he has attained this age, one loses in a moment all the expenses that one has made for him during all his life, without that society had drawn from him the least profit. Does this reason not suffice in order to give the greatest attention to conserve these children until this age of harvest, by preserving them from a malady so murderous which most often attacks precisely only them? If smallpox had a

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<sup>3</sup>Mr. Bernoulli supposes that many poor mothers who carry their infants to the hospital would abstain themselves for fear of inoculation. But when one would suppose that the half of the infants who one carries are legitimate, the small number of those who one reclaims proves only too little of interest who take to their sort those who carry them. (Note of the editor of the *Mercure de France*.)

<sup>4</sup>It is very true that one awaits in Italy only the example of France. (Note of the editor of the *Mercure de France*.)

nature to never attack but the oldest, the political reasons would cease. But it seems to me that the reasons of humanity must yet be the same.

From the general considerations, I pass to some particular reflections on inoculation. An argument which one makes to be worth against this practice, is that a great number of persons never contract small pox. It is true that in regard to these persons the operation becomes manifestly useless; it would likewise be cruel, since one would make them suffer an incommodious malady. I would say again, if inoculation were accompanied by a risk of life be it of so little consequence, that it would be tyrannical & impious; but to all that I have only one word to respond: it is that of gentle sufferings they would not know how to be put in parallel with the least risk of life, & that the risk of life that one courts by inoculation is null or as null. The objection proves only that it would not be necessary at all to practice the insertion on the persons who would never have small pox, if one could distinguish them from the others with it & this is that which I will agree without difficulty. But those who shout so loud take from from the possibility to never have this malady, are they not in contradiction with themselves? They grant the utility of inoculation for the persons who would know to have to take small pox soon; there is however among all these persons around six or seven who would not die of it at all. I would demand therefore to those who make the preceding difficulty, why they would consent to inoculation of all those who would be sure who will be soon attacked by small pox, since the operation would be still inutile to six inoculated out of seven. To this can they give another response as that which I have given above, namely that one would not know how to distinguish the ones from the others, nor consequently to prevent themselves to make indistinctly the operation on all.

Besides the conservation of life is not the only good which results from inoculation. One knows the often troublesome, sometimes terrifying sequence of natural smallpox, & one knows at the same time that they are infinitely rare after the artificial, or rather that they never take place. What proportion further the sufferings of natural smallpox be it so little malignant, & those of the same inoculated malady, when likewise it is the most evil? I attest to it the physicians, those same which declare themselves against inoculation, by an unhappy fatality which I have never been able to comprehend. I am able here to give myself for an eye witness: I have seen many maladies of one & another class. The inoculated would sometimes have a great number of pustules: born in a family quite maltreated by smallpox, I am able to doubt only the natural malady had not removed them; with all that their state would appear to me rather the one of a discomfort than the one of a great suffering. But I myself would not know how to report without being moved the sad state in which I have seen reduced someones of those who have been surprised by natural smallpox.

We examine further in what manner one must envision the danger that one can suppose to accompany inoculation. I will magnify today this nearly null danger, & I will suppose that this operation carried away one out of one hundred of those who submit to it. Must one such risk be to slow down the zeal of a man who has had in view only the good of humanity? One would know better to make sense of these moral truths only by the method of which Mr. *de la Condamine* has made use with so much success. It consists in presenting them under a remarkable point of view which never lacks to draw our conviction; I will follow therefore the example of the illustrious author who has given me occasion to make these reflections.

I consider the mortality caused by the maladies of each kind, which destroy little by little an entire generation. I will partition this total mortality into fourteen classes of different maladies, & I will suppose in order to simplify the thing all these classes equally deadly,

although the ones later [in life] than the others. I suppose moreover that all these maladies would be of the same nature as smallpox, that is to say that one can prevent the fatal effect of each by a preservative of the same kind as Inoculation. We suppose further in order to render all things equal, that all the different kinds of Inoculations, would be accompanied by inconveniences equal to those of inoculated smallpox. All this supposed, it is evident that it is will be necessary either to reject all inoculations, & consequently that of smallpox, or to admit all of them: the concern is therefore only to examine this alternative. If we reject all Inoculations, we remain in our state, which it is necessary to have studied in order to understand all the misery of it. The first year alone carries away according to the different lists, the quarter, the third or more of all humanity. But if one adopts all the kinds of Inoculations, if one hurries to administer them all, in order to prevent more quickly all the dangers; when likewise one would wish to suppose that each kind of insertion would carry away the hundredth part of those who submit to it (a supposition by which one exaggerates the peril to the triple & to the quadruple of reality) then what would result from it? There would be eighty-seven persons out of one hundred or  $87/100$  of the total; this which makes the fourteenth power of  $99/100$ , who would survive all these operations, & thirteen out of one hundred who would succumb to them. These thirteen out of one hundred make hardly the half of the number than all the different maladies carry away naturally in the first year alone. It is necessary therefore to count for nothing this loss, or rather it is necessary to count for a real gain; since it diminishes the half of the ordinary loss; but this is not all.

All the survivors who make the seven-eighths of humanity, would be still exempt from all infirmity in the course of their life; they would go all to the last term of age; they would do no more than cease to live. What difference between our present state & the one which our supposition gives! Let one choose now between the two alternatives that I propose; but let one be reminded that it is to be declared for inoculation from smallpox, than to choose the second part; if Providence had not accorded us this great good in whole, is it necessary for that to reject the part that she offers us?

But perhaps we will attain more surely the end that we propose, if we add here an evaluation of the ravage of natural smallpox, & of that which one can gain in procuring it artificially. I do not pretend to give an absolutely exact evaluation; we do not have enough observations for that; one can supply in truth in this defect by some quite reasonable hypotheses, & at the same time quite near the truth, but I foresee only that one would not know how to make it without some painful calculations; because it is necessary to follow the effect of smallpox, from birth to the last age. I will undertake this work at the first leisure which it will permit me; I will content myself for this time to indicate how we must estimate very nearly the results which we demand.

One has noted by a great sequence of observations, that in comparing the number of those who succumb to smallpox, with the number of those who are attacked by it, the proportion is found to be that of 1 out of 7 or at least 1 out of 8; the difference of them is rather small. I will adopt this last proportion for two reasons: firstly, because it is easier to know the number of all those who die from smallpox, that it is to comprehend the entire number of those who are attacked by it: secondly, I myself take from it the proportion of one out of 8, in order to avoid all suspicion to increase the peril of the disease. If therefore one would wish to suppose that smallpox attacks all infants since their birth, it is manifest that this malady would carry away the eighth part of humanity; since each generation annually would be diminished in ratio of 1 to 7. On the other hand the destruction that smallpox causes in human kind, is the thirteenth or the fourteenth part of total mortality; since it is still constant that out of 13 or 14 who die of all sorts of maladies, one alone is

carried away by smallpox. I must here say in passing, that having consulted many mortality lists, where one makes enumeration of the deaths from smallpox in different countries, the number of 1 out of 13 has to me appeared more conformed to nature, than the one of 1 out of 14. It appears to me also to agree better to the other general notions that we have on this malady; in order to accommodate these two truths of observation, one has only to suppose smallpox of a nature to surprise all children at their entry into the fifth or the sixth year; because a calculation which would not be able to deviate sensibly from nature, has taught me that if all children were exempt from smallpox until the accomplished age of 4 or 5 years, each generation at this age would be reduced from 13 to 8, by all the other causes of mortality. If all the children who compose these  $8/13$  would contract next smallpox there would die of them the eighth part, & this eighth part would make precisely the thirteenth part of the total of the entire generation.

It is therefore under this face that one is able in this regard to consider the ravage of smallpox, & the advantage that there would be if one was able to be exempt from this destruction; since one can say that the destruction caused by smallpox, is very nearly the same as if this malady removed the  $8^{\text{th}}$  part of humanity arrived to the accomplished age of 4 or 5 years. But what commencement of life, & what can be the price of it, either for the children themselves, or for their fathers & mothers, or for society, when they are destined to perish at that age? Does one so small object merit some consideration? Does not one by right neglect it, & say in consequence that smallpox destroyed the eighth part of total humanity? However if one wishes to take account of this small portion of life, as one does in the calculations of mean life, where one gives a price equal to each year of life, one could say that the life of 4 or 5 first years, making around the seventh part of the total mean life, smallpox deprives those that it removes, only of the six-sevenths of their mean life, & that consequently this malady destroyed around the six-seventh of the one-eighth part, of the entire specie, that is to say the three twenty-eighths of the total, this which approaches much one-ninth. I do not give, I repeat it, this evaluation as entirely exact: I hope however to assure that it does not deviate much from the correct value. One sees therefore evidently that smallpox alone removes more than the tenth part of each generation annually, & that this is a true decimation, to which one proposes to be subtracted by means of Inoculation: which as Mr. *de la Condamine* remarks it with much justice, instead of decimating, makes no more than a thousandth those who are put under its safe-keeping. the  $3/28$  of each generation annually that this operation would preserve, would be worth around sixty thousand souls per year in France alone, & all the rest dying equal, one such increase would be able to double the number of inhabitants of the Realm in a century: as much by the conservation of those who would be protected from this plague, as by the multiplication which they would produce.

If these considerations are not strong enough in order to restore those who are opposed with so much animosity to Inoculation, may they, at least, engage all well intentioned people to omit nothing in order to give to this method all the perfection of which it is susceptible.

Those who practice it with the greatest zeal, are they not at all conserved from prejudices? The custom to defer Inoculation until the age of 5 years, is it based on sufficient reasons? I know that at this age where the greatest danger from maladies of infancy is passed, one is less exposed to see the success of the operation disturbed by some strange & unknown causes. But how many infant victims of this fear are harvested from cribs in certain epidemics? I am tempted to believe that by abandoning in England the usage where one was to inoculate the newborn infants, one is less complied to the general good

of humanity, than to the fear to decree this method next to the vulgar, who would impute to it without examination, the ordinary accidents at that age. One day will come perhaps where one will not be forced to these fatal variations. We will be able to enjoy then all the advantages that inoculation offers us; & one will be astonished to have them so long neglected.

*Nota.* The Memoir that Mr. Bernoulli announced in these reflections has been sent to the Academy of Sciences of Paris, of which Mr. Bernoulli is a member. This Memoir has for title: *Essai d'une nouvelle analyse de la mortalité causée par la petite vérole, & des avantages de l'inoculation pour la prévenir.*