## ON THE CALCULABILITY OF THE NUMBER OF ALL POSSIBLE TRUTHS

[End of 1693/Beginning of 1694 (?)]

The entire body of sciences can be thought of as an ocean which is continuous everywhere and without break or division, although men conceive parts in it and give these parts names at their convenience. And just as there are seas which are unknown or which vessels have navigated only by the accident which propelled them there, one may similarly say that there are sciences which one knows about simply by chance meeting and without design or intention. The art of combinations belongs to these; for me it signifies purely the science of forms or formulas, or even of variations in general. In a word, it is the universal specious arithmetic or characteristic. As such it deals with the identical and the diverse, the similar and the dissimilar, the absolute and the relative, just as ordinary mathematics deals with the one and the many, the large and the small, the whole and the part. One can even say that calculation with letters, or more precisely algebra, is in a certain sense subordinate to it, because one employs many signs which are indifferent or which at the beginning of the calculus can be exchanged and mutually substituted without doing any harm to the reasoning. For this the letters of the alphabet are highly suitable. And when these letters or signs signify magnitudes or numbers in general, the result is algebra or rather Viète's specious arithmetic. And it is precisely in this that the advantage of Viète's and Descartes' algebra over that of the ancients consists: that in employing letters instead of either known or unknown numbers one arrives at formulas, in which there is a certain relation and order, and which give our minds the means to note theorems and general rules. In this way, the greatest benefits of algebra are simply examples of the art of characters, whose usage is by no means limited to numbers and magnitudes. Then if these letters were to signify points (as this is effectively practised by geometricians) one would be able thereby to create a certain c a l c u l u s or sort of operation which would be quite different from algebra and which would not cease to have the same advantages as it has. It is about this that I shall speak another time. When these letters signify terms or concepts, as in Aristotle, this gives us that part of logic which deals with figures and modes. I thought deeply on this topic at the beginning of my studies, venturing even to publish a small tract on the art of combinations which was well enough received and later reprinted without my consent. For, having had other ideas on this topic since that time, I would have been able to deal with the matter in quite a different way. Nevertheless, just to mention this in passing, I have noticed in addition this general theorem of logic: that each of the four figures of

syllogism has an equal number of useful modes, and that in each figure there are six modes. Finally, when the letters or other characters signify true letters of the alphabet, or of the language, then the art of combinations together with consideration of the languages gives us cryptography.

I have already mentioned that there is a calculus of combinations where that which is composed is not a collective, but a distributive whole, that is to say, where combined things may only contribute alternately. And this calculus has again its own laws quite different from those of algebra. Finally, general specious arithmetic takes on a thousand forms whereas algebra contains but one.

Now without entering into a particular discussion on the laws which diversify general specious arithmetic, one is able to combine it with arithmetic in calculating the number of possible variations which the general signs may take on. These variations may be taken in different ways and in the writings which we create employing the letters of the alphabet there is a variety both as regards the letters themselves and as regards the arrangement of the letters, as well as the intervals or distinctions (since we do not write without a break, but rather leave a distinction between the words). Now, since all human knowledge can be expressed by the letters of the alphabet, one can say that he who perfectly understands the usage of the alphabet knows all. It follows from this that one could calculate the number of truths of which human beings are capable, and that one can ascertain the size of a book which would contain all possible human knowledge. And in this there would be all which could ever be known, written or discovered, and even more in addition. For it would contain not only the truths but also the falsities which men are able to utter, and even those expressions which mean nothing.

This investigation serves to let us understand better how small man is in relation to the infinite substance. Then the number of all the truths which all men together are able to know is small enough even if there be an infinity of men who throughout all eternity strive towards the advancement of knowledge, and supposing always also that human nature be no more perfect than it is at present. Then it is here not a matter of another life where the human mind will be raised to a more elevated state. This paradox has quite a different force from that of Archimedes, who made the courtiers of King Heron aware that the number of grains of sand which would fill not only the whole earthly globe but also the space of a good part of the universe (understood as being from here to the stars) is small enough and easy enough to be written down, then this number is almost nothing in relation to that of all truths. For there is no grain of sand which does not have its own particular shape and which could not provide us with a large number of truths, not to

speak of the truths gained from other things. From this it nevertheless does not follow that if the earth (together with the human race) were to last long enough one could only find truths that had already been known earlier, because the human race will be happy to have a certain small number of truths during a whole eternity, which will be no more than a part of those of which it is capable. Thus it will always leave something behind. But supposing that one always proceed in advance (during which one may nevertheless proceed slowly perhaps, so long as progress always remains the same) it is necessary eventually that all will become exhausted and that one then cannot even write a novel which another has not already written, nor create a new fantasy. Thus it will always be necessary that literally a day will come, on which one can say no more than what has been said already, *nihil dici, quod non dictum sit prius*. For, where one says that which has already been said, or even if one wants to continue to say new things, one will exhaust that which still remains to be said, since this is finite, as we have already shown. It is a case then of giving a number which is greater than the number of all which can be said or pronounced. It is this which we set out to do.