

THE MODERN STUDENT'S LIBRARY

LEIBNIZ

Selections

EDITED BY

PHILIP P. WIENER

PROFESSOR OF PHILOSOPHY
THE CITY COLLEGE, NEW YORK

EXECUTIVE EDITOR

Journal of the History of Ideas

CHARLES SCRIBNER'S SONS

NEW YORK

1951

4. PREFACE TO THE GENERAL SCIENCE
[1677]

Since happiness consists in peace of mind, and since durable peace of mind depends on the confidence we have in the future, and since that confidence is based on the science we should have of the nature of God and the soul, it follows that science is necessary for true happiness.

But science depends on demonstration, and the discovery of demonstrations *by a certain Method* is not known to everybody. For while every man is able to judge a demonstration (it would not deserve this name if all those who consider it attentively were not convinced and persuaded by it), nevertheless not every man is able to discover demonstrations on his own initiative, nor to present them distinctly once they are discovered, if he lacks leisure or method.

The *true Method* taken in all of its scope is to my mind a thing hitherto quite unknown, and has not been practised except in mathematics. It is even very imperfect in regard to mathematics itself, as I have had the good fortune to reveal by means of surprising proofs to some of those considered to be among the best mathematicians of the century. And I expect to offer some samples of it, which perhaps will not be considered unworthy of posterity.

However, if the Method of Mathematicians has not sufficed to discover everything that might be expected from them, it has remained at least able to save them from mistakes, and if they have not said everything they were supposed to say, they have also not said anything they were not expected to say.

If those who have cultivated the other sciences had

imitated the mathematicians at least on this point, we should be quite content, and we should have long since had a secure Metaphysics, as well as an ethics depending on Metaphysics since the latter includes the sort of knowledge of God and the soul which should rule our life.

In addition, we should have the science of motion which is the key to physics, and consequently, to medicine. True, I believe we are ready now to aspire to it, and some of my first thoughts have been received with such applause by the most learned men of our time on account of the wonderful simplicity introduced, that I believe that all we have to do now is perform certain experiments on a deliberate plan and scale (rather than by the haphazard fumbling which is so common) in order to build thereupon the stronghold of a sure and demonstrative physics.

Now the reason why the art of demonstrating has been until now found only in mathematics has not been well fathomed by the average person, for if the cause of the trouble had been known, the remedy would have long since been found out. The reason is this: Mathematics carries its own test with it. For when I am presented with a false theorem, I do not need to examine or even to know the demonstration, since I shall discover its falsity *a posteriori* by means of an easy experiment, that is, by a calculation, costing no more than paper and ink, which will show the error no matter how small it is. If it were as easy in other matters to verify reasonings by experiments, there would not be such differing opinions. But the trouble is that experiments in physics are difficult and cost a great deal; and in metaphysics they are impossible, unless God out of love for us perform a miracle in order to acquaint us with remote immaterial things.

This difficulty is not insurmountable though at first

while there will not be enough given circumstances to form an infallible judgment, we shall always be able to determine what is most probable on the data given. And that is all that reason can do.

Now the characters which express all our thoughts will constitute a new language which can be written and spoken; this language will be very difficult to construct, but very easy to learn. It will be quickly accepted by everybody on account of its great utility and its surprising facility, and it will serve wonderfully in communication among various peoples, which will help get it accepted. Those who will write in this language will not make mistakes provided they avoid the errors of calculation, barbarisms, solecisms, and other errors of grammar and construction. In addition, this language will possess the wonderful property of silencing ignorant people. For people will be unable to speak or write about anything except what they understand, or if they try to do so, one of two things will happen: either the vanity they will learn by writing or speaking. As indeed those who calculate learn by writing and those who speak sometimes meet with a success they did not imagine, the tongue running ahead of the mind. This will happen especially with our language on account of its exactness. So much so, that there will be no equivocations or amphibolies, and everything which will be said intelligibly in that language will be said with propriety. This language will be the greatest instrument of reason.

I dare say that this is the highest effort of the human mind, and when the project will be accomplished it will simply be up to men to be happy since they will have an instrument which will exalt reason no less than what the Telescope does to perfect our vision.

~~It is one of my ambitions to accomplish this project.~~

METHOD

~~if God gives me enough time. I owe it to nobody but myself, and I had the first thought about it when I was 18 years old, as I have a little later evidenced in a published treatise (*De Arte Combinatoria*, 1666). And as I am confident that there is no discovery which approaches this one, I believe there is nothing so capable of immortalizing the name of the inventor. But I have much stronger reasons for thinking so, since the religion I follow closely assures me that the love of God consists in an ardent desire to procure the general welfare, and reason teaches me that there is nothing which contributes more to the general welfare of mankind than the perfection of reason.~~

5. TOWARDS A UNIVERSAL CHARACTERISTIC

[1677]

An ancient saying has it [Wisdom 11:20-21.] that God created everything according to weight, measure, and number. However, there are many things which cannot be weighed, namely, whatever is not affected by force or power; and anything which is not divisible into parts escapes measurement. On the other hand, there is nothing which is not subsumable under number. Number is therefore, so to speak, a fundamental metaphysical form, and arithmetic a sort of statics of the universe, in which the powers of things are revealed.

~~That the profoundest secrets are hidden in numbers has been a conviction of men ever since the time of Pythagoras himself who, according to a reliable source, transmitted this and many another intuition to Greece from the Orient. However, since the right key to the secret was not possessed, man's curiosity was led to nullities and superstitions of all sorts from which arose a kind of~~

14. ON THE LOGIC OF PROBABILITY

[From *New Essays*, bk. IV, ch. II, On Probability, 1704]

Opinion, based on the probable, also deserves perhaps the name knowledge; otherwise nearly all historical knowledge and many other kinds will fall. But without quarreling over names, I hold that the investigation of degrees of probability would be very important, that we are still lacking in it, and that this lack is a great defect of our Logic. For when we cannot decide a question absolutely, we might still determine the degree of likelihood from the data, and can consequently judge reasonably which side is the most likely. And when our moralists (I mean the wisest ones, such as the present-day General of the Jesuits) join "the safest" with "the most probable" and even prefer the safe to the probable, they are not in fact far removed from the most probable; for the question of safety is the same as that of the small probability of an evil to be feared. The fault of the moralists, lax on this point, has been in good part due to too limited and inadequate notion of the probable which they have confused with Aristotle's *endoxon* or *opinabile*; for Aristotle in his *Topics* meant only to show how one accommodates himself to the opinions of others, as the orators and Sophists did. Endoxon for him means what has been accepted by the greatest number of people or the most authoritative; he was wrong in restricting his *Topics* to that, and this view caused him to adhere only to the accepted maxims, for the most part vague, as if he wished to reason only by means of quodlibets or proverbs. But the probable is more extensive; we must derive it from the nature of things; and the opinion of persons whose authority has weight is one of the things which may contribute to rendering an opinion likely, but it is

not what completes the whole verisimilitude. And when Copernicus was nearly alone in his opinion, it was still incomparably more probable than that of all the rest of mankind. Now I do not know but that the art of estimating verisimilitudes would not be more useful than a good part of our demonstrative sciences, and I have often thought about it.

(From *New Essays*, bk. IV, ch. XV)

Rather than say [with Locke] that probability is based on agreement with our knowledge or on the testimony of persons we know, I should prefer to hold that it is always based on likelihood (*verisimilitude*) or agreement with the truth; and the testimony of others is also pertinent to the truth regarding facts within their reach. It then may be said that the similarity between the probable and the true is grounded either on internal or external considerations. The rhetoricians employ two kinds of arguments: artificial ones, based simply on reasoning about things, and non-artificial ones, based exclusively on the expressed testimony of men or perhaps also on the evidence of things themselves. But then there are also mixed arguments, since testimony may supply a fact which is used to form an artificial argument.

The sworn testimony of men is undoubtedly of greater weight than mere opinions, and the testimony adduced in rational argument is a result of greater deliberation. As you know, a judge at times makes witnesses take an oath of credibility (*de credibilitate*); in the examination of witnesses they are often asked not only what they have seen but also what they think, asking them at the same time to give their reasons for their judgment and whether they have carefully considered them as they should. Judges also very often heed the views and judgments of experts in each profession; private persons are equally

compelled to do so to the extent that they find it inconvenient to arrive at an independent judgment. Thus a child, or other human whose condition is but little better in this respect, is obliged, whenever he finds himself in a certain situation, to follow the religion of the country so long as he sees nothing wrong in it and is in no position to inquire whether there is a better one. A supervisor of pages, whatever his own sect, will compel each of them to go to the church of those who profess the same belief as this young man. We may consult the disputes between Mr. Nicole and others on *the argument from the majority* in matters of faith, in which sometimes too much deference is given to it and at other times too little consideration. There are other similar preconceived judgments by which men too easily evade discussion. They are what Tertullian, in a treatise, expressly called *prescriptions* [against heretics appealing to Scriptures in their own defense], using a term which the old jurists intended for several sorts of exceptions or irrelevant and incompetent allegations, but which today means simply the temporal injunction against another's claim because it was not made in the time fixed by law. Thus there was reason for making public the *legitimate prejudgments* on the part of both the Roman Church and the Protestants. For example, both have found means of opposing novelty in each church respectively: when the Protestants for the most part abandoned the old form of ordination of clergymen, and when the Romanists changed the old canon of the Old Testament in Holy Scripture, as I have shown clearly enough in a dispute I had with the Bishop of Meaux [Bossuet], who has just died, according to the news which came a few days ago. Thus, while these censures are reciprocal, although novelty gives rise to some suspicion of error, it is not a certain proof of error.

ON DEGREES OF PROOF

METHOD

85

(From *New Essays*, bk. IV, ch. XVI)

. . . Jurisconsults in treating the proofs, presumptions, conjectures and indices have said a number of good things on this subject (of degrees of assent), and have entered into some considerable detail. They begin with *notoriety*, where there is no need of proof. After that they come to *entire proofs*, or those which pass as such, on which they pronounce judgment, at least in a civil suit, but in which in some localities they are more reserved in a criminal action; and they are not wrong in demanding in such a case *more than full proof*, especially what is called *corpus delicti* according to the nature of the act. There are therefore *proofs more than full* as well as customary *full proofs*. Then there are *presumptions* which pass for entire proofs provisionally, that is to say, so long as the contrary is not proved. There are *proofs more than half complete* (to speak strictly) in which the party who bases his action on them is permitted to swear he will supply the rest; this is *juramentum supplicitorium*; there are others *less than half complete* in which quite contrariwise the party that denies the act is permitted on oath to purge himself (*juramentum purgatorium*). Beyond this there are many degrees of *conjecture* and *indices*. And particularly in a criminal case there are indices to proceed to the torture (*ad torturam*) which itself has many degrees indicated by the rules of arrest; there are indices (*ad terrendum*) sufficient to show the instruments of torture and to prepare things as though they were going to be applied. There are some (*ad capturam*) to make sure of a suspect; and some to make inquiries secretly and quietly (*ad inquirendum*). And these differences may be useful again on other corresponding occasions; the entire *form of juridical procedures* is in fact nothing but a species of

Logic applied to questions of law. Physicians also have a number of degrees and differences in their signs and indications which may be seen among them.

The Mathematicians of our day have begun to estimate chances in connection with gambling games. Chevalier de Mére, whose *Agréments and other works* have been printed, a man of penetrating mind who was both a gambler and a philosopher, provided the mathematicians an opportunity by forming questions about bets, in order to know how much the game would be worth if it were interrupted at such or such a stage. In that way he persuaded his friend Pascal to look into these things a little. The question aroused much interest and provided Huygens the occasion to write his treatise on chance (*De Alea*). Other scientific men got into the subject. They established some principles which the Pensioner De Witt used in a little treatise printed in Holland on annuities. The foundation on which he built goes back to *prosthesphaeresis*, that is, to taking an arithmetical mean among several equally acceptable hypotheses, and our peasants have long used it in doing their natural mathematics. For example, when some inheritance or land is to be sold they form three groups of estimators; these groups are called *Sohrszen* in Low Saxon, and each group makes an estimate of the property in question. Then suppose that the first estimates the value to be 1000 crowns, the second 1400, the third 1600; they take the sum of these three estimates which is 3900 and because there were three groups, they take a third or 1300 for the required mean value; or else, what amounts to the same thing, they take the sum of the third part of each estimate. That is the axiom of *aequalibus aequalia*, equal hypotheses must have equal weight. But when the hypotheses are unequal, we make comparisons among them. Let us suppose, for example, that with two dice

one is to win if he rolls a 7 but his adversary is to win if he makes a 9; we ask what is the ratio of their probabilities of winning? I say that the latter's probability is only two thirds that of the first, for the first can make 7 in three ways (1 and 6, or 2 and 5, or 3 and 4) and the other can make 9 in only two ways (3 and 6, or 4 and 5). And all these ways are equally possible. Hence, the probabilities, which are to each other as the number of equal possibilities, will be in the ratio of 8 to 2, or as 1 to $\frac{2}{3}$. I have more than once said that we should have a new kind of Logic which would treat of degrees of probability, since Aristotle in his *Topics* has done nothing less than that, and was content with putting in order certain popular rules distributed according to common topics which may be useful on some occasion where it is a question of amplifying a speech and giving it some semblance of truth. But he did not take the trouble to give us a necessary balance to weigh probabilities and to form solid judgments accordingly. It would be well for future investigators of this matter to pursue the examination of *games of chance* and in general I should wish some skillful mathematician might want to write an ample work, with full details and thought out well, on all sorts of games; this would be very useful for perfecting the art of discovery, the human mind revealing itself better in games than in the most serious matters.

(Letter to Bourguet, 1714)

... Syllogistic Logic is truly demonstrative, just as Arithmetic or Geometry. I was in my youth demonstrated not only that there are really four figures, which is easy, but also that each figure has six useful moods, and cannot have either more or less, whereas ordinarily only four are given to the first and second,