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1

The Triumph of Probability Theory

> *La réflexion sur la chance dénude justement le monde de l'ensemble des prévisions où l'enferme la raison.*
> —GEORGES BATAILLE, *Le Coupable*

> *Fortuna was traditionally the very personification of surprise, . . . each unpredictable spin of her wheel turning the world upside down. The story of probability and statistics is one of the domestication of unpredictable Fortuna.*
> —LORRAINE DASTON, in *The Empire of Chance*

These two statements, the first from Georges Bataille's *Le Coupable,* of 1943, the second from the closing paragraph of a recent study of probability theory published in Cambridge's Ideas in Context series, evoke the two perspectives from which I will examine the development of probability theory from its origins in the work of Blaise Pascal through the Enlightenment and the early nineteenth century. Bataille's claim that an understanding of chance dissolves the cogency of any science born of reason is part of a series of philosophical reflections on liberty, fear, and *le hasard* collected in the chapter entitled "L'Attrait du jeu."[1] Daston's statement is from a collective work by a group of historians and social scientists subtitled "How probability changed science and everyday life."[2] Their focus, unlike Bataille's, is on the specific historical practices that resulted from the development and growing influence of what came to be called probability theory and would, in the nineteenth century, assume the more imperial demeanor of statistics.

Moving between the abstract and the concrete, I would approach the cultural history of probability theory through two figures from the classical period who played crucial roles in determining what would be the eighteenth century's most concerted strategies in responding to the challenge of chance. Pascal's Jansenistic theology, his conviction as to our utter dependence on divine grace and our inability to merit salvation through works, was part of a radical skepticism concerning humankind's ability to dominate, understand, or control the world of which it was a part. At the same time, and very much in relation to that skepticism, Pascal, in his correspondence with Fermat and his *Traité du triangle arithmétique*, laid the foundations for a mathematical assault on chance, promising in the most optimistic tones that our mastery of blind fortune could achieve all the exactitude and certainty of the geometric method through which he would analyze it. Speaking of what before him had been the incomprehensible puzzle of chance, Pascal wrote: "eam quippè tanta securitate in artem per Geometriam reduximus, ut certitudinis ejus particeps facta, jam audacter prodeat."[3] In *The Emergence of Probability*, Ian Hacking analyzes *Les Pensées*'s famous meditation on the wager. He shows that the sequence of stages in Pascal's debate between the believer and the libertine in fact results from a precise application to that subject of the mathematical analysis of expectations Pascal had developed in his earlier works on probability.[4] This coherence between Pascal's scientific and philosophical work, between his all but obsessive mathematization of every human situation and his acute awareness of the ultimate limits of human reason, suggests that we must look for the real motivation of his work on chance beyond the reductive legend attributing his role as the founder of probability theory to an encounter with an aristocratic gambler as incongruous as it was fortuitous. It was the nineteenth-century mathematician Siméon-Denis Poisson who first consecrated this legend in the opening page of his 1837 treatise on probability theory: "A problem related to games of chance, put

to an austere Jansenist by a man of the world, was at the origin of the calculus of probabilities."[5] If Pascal was to impose upon chance a methodology and a rhetoric holding out a promise of certainty where before there had been only an insuperable challenge to human reason, it was not simply because he counted among his acquaintances the devoted gambler, the chevalier de Méré. The real motivation for Pascal's fascination with what would come to be known as probability theory lay in his far more fundamental compulsion to work through and against an acutely somber vision of the limits of human understanding.

René Descartes, in a well-known passage in *Le Discours de la méthode*, reveals a similar obsession with salvaging from a situation of complete uncertainty some nonetheless certain method for "advancing," for "moving forward." He adopts as the second maxim within his strategy for escaping his starting point in radical doubt the obligation to act as firmly and resolutely as possible in all actions. Descartes justifies this paradoxical response to the challenge of doubt with his metaphor of a man lost in a forest. With no idea where he might be, no sense of which direction he should take, it becomes all the more important that he feign an at least provisional certainty within his objective uncertainty: "Acting in this way like travelers who, lost in a forest, must not wander about, turning now one way and then another, and even less remain set in one spot, but must march ahead in one direction in as straight a line as possible, never changing their course for slight reasons, even though at the outset it was only chance that led them to choose that direction."[6] Thanks to the bootstraps effect of this strategy, a situation first defined as depending on *le hasard seul* yields both escape and salvation when approached through the protocols of certainty.

The examples of Pascal and Descartes are important because each shows in a different way how, against a background of radical skepticism, there emerged both the desire and an actual mathematical method for arriving at a new form of certainty based on a permutational analysis of human contingency and thus possessing none of the abstract universality associated with the scholastic concept of an indubitable and apodictic *scientia*.[7] This new certainty was, finally, a particular valence of doubt. And without that origin in doubt, its rhetoric of promised understanding could never have achieved the imperious militancy it was so consistently to display.

In the second forward to his *De Ratiociniis in aleae ludo* (1657), Christiaan Huygens speaks frankly about the dizzying aspirations of this new science. The task before mankind, an endeavor in which Huygens sees himself as a principal contributor, is to make others aware of the large and previously unsuspected domains over which "our marvelous Algebraic Art" extends. In conquering these provinces of real life experience, the new algebra of hazards will use what first seemed an impossible challenge to produce the most convincing proof of its efficacy: "The more it seems difficult to use reason to analyze what is uncertain and subject to chance, the more the science accomplishing that feat will appear admirable."[8]

Pierre Rémond de Montmort offers in his *Essai d'analyse sur les jeux de hasard* (1708) the first application to card games of the mathematical techniques developed by Pascal, Fermat, Bernoulli, and Huygens. In fact, the careful descriptions Montmort gives of the card games before his analyses of their probabilities constitute the best summaries we have of what were some of the most popular card games of the late seventeenth and early eighteenth centuries: pharaon, lansquenet, le jeu du treize, basset, piquet, and hombre. In his introduction Montmort explains that his careful scrutiny of so apparently frivolous a subject as the intricacies of popular card games carries with it the serious advantage of allowing him to vanquish, on its home ground, that most decried of all Enlightenment evils: superstition. "It is especially in games of chance that the weakness of the human mind and its tendency toward superstition manifest themselves. . . . And it is much the same for people's behavior in all those areas of life where chance

plays a role. The same prejudices govern them, and imagination dictates their conduct, blindly giving birth to fears and hopes."[9]

If superstition exercises so great a sway over our actions in the domain of card playing, it is because we are ignorant, because we remain unaware that there are in fact hidden laws regulating every turn of the cards. The task before Montmort is obvious: "I thus thought it would be useful, not only for gamblers, but for mankind in general, to show that chance does obey knowable rules and that, for not having learned those rules, we make mistakes every day whose unhappy consequences should far more reasonably be attributed to us than to the destiny we lament" (vii). Montmort's analysis of card games, his contribution to the development of probability theory, is philosophically conceived as a demonstration that there exists no capricious superior power, no Fortuna or *hasard*, determining the fall of the cards. The only divinities at work in what the superstitious mistakenly persist in seeing as a brush with fortune are the mathematically calculable ratios between the chances for the card we want and the chances for all other possible outcomes.

This, however, is not the only lesson of the cards. Within the perfectly systematic calculations sustaining Montmort's analyses, the truly wise reader is invited to discover the careful hand of the Creator, the presence of a Newtonian first cause responsible for a perfect order. Anticipating Laplace by more than half a century, Montmort redefines *le hasard* as nothing more than an index of our ignorance: "Strictly speaking, nothing depends on chance. In studying nature, one soon learns that its Author acts everywhere and always with wisdom and infinite foresight. If we are to give the word *chance* a meaning congruent with true philosophy, we must conclude that as all things are determined by fixed laws, only those whose natural causes remain hidden from us are seen as depending on chance" (xiv).

The purpose behind Montmort's analysis of card games is consonant with the fundamental endeavor of the Enlightenment. Our natural world, even that of apparent chance, is regulated by hidden rules structured in so orderly a fashion that mankind will one day surely complete his understanding of it. As we move toward that goal, we will, territory by territory, conquer the purely illusory realm of chance—a pseudo-power incarnating nothing more than our waning ignorance of natural causalities.

In his *Doctrine of Chances* (1718) Abraham De Moivre, the Huguenot mathematician who chose lifelong exile in England after the revocation of the Edict of Nantes, makes clearer than any of the major writers on probability theory what the real goal of this new science was. Examining those spheres of human activity where chance was assumed to play a part, the doctrine of chances will reduce that concept to one of utter insignificance, to a "mere word" fit only for those "blinded by metaphysical dust." "But *Chance*, in atheistical writings or discourse, is a sound utterly insignificant. It imports no determination to any *mode of Existence;* nor indeed to *Existence* itself, more than to *non-Existence*. It can neither be defined nor understood; nor can any Proposition concerning it be either affirmed or denied, excepting this one, 'That it is a mere word.'"[10]

Each of these passages from prefaces and addenda to early works of probability theory bases the value of their collective enterprise on its contribution to the emerging understanding of a system of laws banishing all belief in chance. But what, we must ask, is actually happening within these treatises on probability? The real order and systemicity offered the readers of these works lie within the mathematical analyses themselves. The truly new order being revealed in these works is that of the theory itself, of the theoretic construct through which the finite permutations of a given aleatory situation are inventoried and compared.

The theory of probability does offer a response to

chance, does generate a distinct scientific enterprise. It is able to do so, however, only by first relinquishing any claim it might make to speak of what, from the viewpoint of the player, the gambler, the person awaiting the outcome of the chance event, is most crucial: the present moment, what will actually happen next, the specific event. As a science of chance, probability theory may speak of the real; but it does so only by first stepping outside the real, by adopting as its vantage point a distant, removed position excluding all real involvement with any one outcome as opposed to another.[11] The reality about which probability theory speaks is always an abstracted real without compelling pertinence to any specific moment or situation.

Probability theory can say a great deal about the expectations I might legitimately entertain that a given number will appear when I roll two dice. What the theory tells me about those expectations forms a relevant context to my decision whether and what I will wager. Probability theory has, however, nothing to say about what number will actually come with the next roll. Thanks to the lessons of probability theory, I feel I know more, and I do know more. But there where I most want it to speak, it remains forever mute.

Like any *theory* of reality, probability "works" only to the extent it is able to substitute its representation of the real, its model, for the reality it sets out to explain. To the question, What *will* happen? it offers an exquisitely refined understanding of what *may* happen. As a science, the eighteenth century's doctrine of chances offered no new knowledge of any specific event. Instead, it spoke eloquently of all possible alternatives within the anticipated event. Coaxing us away from what it dismissed as a compulsive and primitive fixation on *the* result, probability theory asked its readers to focus instead on complex combinatorial permutations of all possible results. Silent with regard to the one, it spoke endlessly of the many.

Addressing this question of the limits of probability theory, the twentieth-century philosopher of science A. J.

Ayer expressed its fundamental paradox in the following terms: "No conclusions about any matter of fact can be derived solely from the calculus of chances. There are no such things as the laws of chance in the sense in which a law dictates some pattern of events. In themselves the propositions of the calculus are mathematical truisms. What we can learn from them is that if we assume that certain ratios hold with respect to the distribution of some property, then we are committed to the conclusion that certain other ratios hold as well."[12] Probability theory has in fact carried off an enormously seductive slight of hand, making the embarrassingly visible rabbit of our ignorance vanish into the decidedly thick air of complex equations. There where we feel most acutely the limits of our knowledge—as we try to know what specifically will happen next in a situation governed by chance—the calculus of probabilities offers a demanding and rigorously mathematized discourse bristling with apparent proofs of our mastery over a situation that in fact escapes us completely.

The new understanding suggested by probability theory carried with it cultural implications that were to change profoundly the way we think about the world, about society, and about the individual's place within it. What was happening in the development of this new science, in the contour of the very different way it asked us to look at the world, was perhaps most apparent in the elaboration, first by Jakob Bernoulli in 1713 and most completely by Poisson in 1835, of a "law" endowed with the convenient power to guarantee that, properly understood, the pronouncements of probability theory would always be correct: the law of large numbers.[13] Claiming that the frequency of events will, over the long run, always conform to the mean of their probabilities, this law dictates that the theorems of probability hold true on the one condition that the number of occurrences within the sample be sufficiently large. If we toss a coin only twice, it can easily happen that, rather than one heads and one tails, we encounter a 100 percent frequency of one alternative or the other. As we increase

the number of tosses toward infinity, however, the fifty-fifty distribution predicted by this simplest level of probability analysis will prove more and more valid.

The law of large numbers, confirming probability theory's inability to speak of *this* event within *this* situation at *this* moment, implies that this new science may speak of the specific event only to the extent that it has become part of, cosubstantial with, a larger group, a larger number, outside of which the calculus of probability holds little validity. What we now call the law of large numbers is important because, more than any other single aspect of probability theory, it shows the role played by this new science in the consolidation of specific sociopolitical practices crucial to the development of Enlightenment ideology. What we see happening in this newfound branch of mathematical investigation, first modestly known as "the doctrine of chances" but, with Laplace, ambitiously rechristened "the calculus of probabilities," is an elimination of chance that carries with it both a redefinition of the individual and a foundation for the period's most important ideological constructs. The premise that the understanding of the individual can be complete and effective only when that individual has become one within a large number, one member of a group, is a guiding principle of the most important aspects of Enlightenment thought.

Rousseau's theory of the *volonté générale* depends on a structurally similar transformation through which the individual ascends to the higher moral level of the citizen. Rousseau's model of the modern state demands that each individual merge into and identify with all other members of the community in such a way that as each becomes a citizen, all come to participate equally in the collective privilege of sovereignty. Rousseau's analysis of the relation between the individual and general wills directly parallels the way probability theory addresses the question of the specific chance event through an abstraction from the single turn of the card or roll of the dice toward a higher level of reflection situating that event within the repertory of all possible outcomes. In both cases a superior value is attributed to that which concerns the collectivity as opposed to the individual.

At a different but again structurally similar level of reflection, Kant adopts as the foundation of his ethics an imperative implying that the individual's access to a norm of correct conduct hinges on his being able to extend *to all others* the dictates of any position the self would adopt individually. Everything that might once have been framed in the context of the single individual finds itself redefined by the presupposition that any true understanding of that singularity necessitates the individual's being absorbed within the group, the large number, the ambient community.

Inspired by the same lesson of probability theory, Condorcet set out to apply the work of his younger friend Laplace to the specifically political question how one might guarantee that such deliberative bodies as judicial tribunals and legislative assemblies will make correct decisions as they judge the guilt or innocence of an accused and as they frame laws for society. In his *Essai sur l'application de l'analyse à la probabilité des decisions rendues à la pluralité des voix* (1785), Condorcet carried out a careful if somewhat laborious analysis of how society might be sure of achieving such results. For Condorcet, this involved exercising control over a series of numerical variables. On the one hand, there was the number of members sitting in such bodies and the majority required for a binding decision. On the other hand, there was a different kind of variable: the probability that each member of such a body, as a more or less rational individual, would arrive at the correct decision in a specific situation. And here, Condorcet argued, the real value of his proposed system lay precisely in the fact that an adjustment within one of those variables could easily compensate for a deficiency in the other. When dealing with educated and objective individuals, from whom the likelihood of a correct decision was high, their total num-

ber, as well as the majority required for closure, could be quite low. When, however, the deliberating body was composed of individuals in whom one had less confidence, both the total number of members and the majority required for closure could be increased. Even though, in other words, some members (and even many members) might be wrong, this deficiency at the level of the individual could be recuperated as an avenue toward truth once all such individual judgments had been integrated within a larger collectivity and a more rigorous definition of the required majority.

In attempting to understand the social and political implications of classical probability theory, it is instructive to look beyond the eighteenth century to that science's continuation and culmination in the work of a figure such as Emile Borel, the early twentieth-century mathematician who stands as the most eloquent heir to the French Enlightenment tradition. Borel enunciated, more clearly than any other single voice, the implications of probability theory and its development into statistical analysis in what he called *les mathématiques sociales.* Only a firm grounding in such "social mathematics," Borel insists, can guarantee a correct appreciation of the relation between the individual and the group, an appreciation recognizing that the only *true* individualism is what he calls a "collectivized individualism":

> Is there then no basis to the opposition between probability theory and individualism? To the contrary, there is a very real one in that individualism is antisocial, whereas probability theory lays the foundation for what might be called *social mathematics.* Its study reminds us that we are part of society and that social phenomena have their own existence and their own interest. Probability theory tells us that even though individuals differ in many ways, they are similar in their liability to accident, to illness, and to death. . . . For

> that reason the study of probability theory has great educational value. As a discipline, it should be taught to all who aspire to a role in the administration of men and of things.[14]

What is most intriguing about this statement is the way Borel, in making his case for a "collectivized individualism," attempts to clinch his argument by referring to precisely that instance of chance over which probability theory can most obviously exercise no real power at the level of the individual: "they are similar in their liability to accident, to illness, and to death."

What emerges even from this rapid overview of the triumph of probability theory and its expanding political corollaries is the way this new understanding of the individual through the group relies on a process of circular reasoning. Throughout the eighteenth century, the individual was called upon to act in accord with various dictates of nature and reason. Yet those dictates become most audible and compelling only when, according to the same mechanics we have seen at work in the theory of probability, the individual was approached, not as a specific case defined by its singularity, but as a random sample from, and potential illustration of, probable laws valid only at the level of the large number, the encompassing group.

Given this reliance on the law of large numbers, on the necessity of the sufficiently large sample, it is not surprising that probability theory, at the service of (and itself well served by) a progressively more centralized state, should have found its most ambitious applications in the development of statistics.[15] More than any other single figure, it was Adolphe Quételet, Laplace's Belgian disciple, who, exploiting the ever more massive statistical data gathered by state offices, articulated the crucial ideological implication of this new discipline: that of *l'homme moyen.* According to a dynamics that the various coercions of the twentieth century have made eminently clear, this mythic "average

man" quickly became not only a mathematical mean but the always eloquent spokesperson of a comminatory social imperative denouncing all difference as deviation.

The development of probability theory from the writings of Pascal through its nineteenth-century mutation into the discipline of statistics brought with it profound changes in the form of the historical consciousness imposed upon the individual. The early doctrine of chances, with its promise of at least partial knowledge in those vast areas where before there had been only the uncertainty of chance, contributed in an important way to the Enlightenment's emerging ideal of rational man. More than anything else, probability theory was a mathematized protocol providing individuals with the tools necessary to quantify and carefully measure the array of alternatives before them and thus ensure what seemed to be the ultimate rationality of their actions. Ideally, any situation falling within the realm of what Locke called "the twilight of probability" could now be broken down into a series of options each of which could be assigned a quantitative probability in relation to the desired outcome. As a series of major scientific works effecting what has been described as the most important mutation in human thought since Aristotle, the works of Pascal, Huygens, Leibniz, Montmort, Bernoulli, De Moivre, Condorcet, and Laplace assumed as their audience a new elite of fully rational individuals capable of understanding and applying the lessons of this new science both to themselves and to their political participation in the life of the community. Developed by and addressed to such an elite, the calculus of probability was based on and militated in favor of a vision of the individual as a consciousness freed from prejudice, superstition, and the unexamined ballast of tradition. Those who would calculate probability theory's complex permutations of the possible present were unencumbered by any allegiance to a past or a history extending back beyond their canny analyses of the specific situation in which a decision had to be made.

This concentration of the self within a faculty of reason situated entirely in the present represented a major shift away from a quite different ethos dictating that individuals locate their most profound sense of themselves within a concrete history linking them to, and defining them through, the temporal continuities of family and class. For the noble, this was the obvious continuity of an illustrious ancestry to be honored and perpetuated. For the merchant or tradesman, it was a commercial position defined and safeguarded by the continuity of a guildlike economic system. For the peasant, it was a piece of land passed down from generation to generation.

Very much in opposition to this diachronic sense of the self as the continuation of an identity anchored in a history of families, institutions, and inheritances, probability theory proposed and consolidated a new form of subjectivity structured as the pure synchrony of rational individuals living within and carefully evaluating the complete paradigm of lateral options available at each successive moment of their lives. For Laplace, classical probability theory's most eloquent and most influential spokesman, the ultimate value of this new science lay in its imperative that rational individuals, acting within a rigorously deterministic world, model themselves after the ideal of a superior, all-knowing intelligence for whom all subjection to human temporality, to the plodding sequentiality of past, present, and future, would cease: "Given for one instant an intelligence able to comprehend all nature's forces and the respective situations of all it comprises—an intelligence vast enough to analyze all those data—it would include in a single formula the movements of the greatest bodies of the universe and those of its lightest atom. For it, nothing would be uncertain, and the future, like the past, would be present to its eyes."[16]

The subsequent development of probability theory into

the ever more pervasive discipline of statistics consolidated yet at the same time shifted the orientation of this new consciousness of self. Rather than to the traditional Enlightenment ideal of the single, rational consciousness confronting and mastering the uncertainties of the present, the new science of statistics coaxed the individual toward an always comparative understanding and valuation of the self. The statistical consciousness came only by measuring the self against a potentially infinite series of averages and means. Statistical understanding juxtaposed the self, as one in no way privileged unit, with data relating it to all other such units throughout society. The growing force of such concepts as the "average man" and the "normal man" proclaimed the necessity that one's actions be understood through their integration within all the similar and different actions undertaken by that vast mass of others from whom the data and conclusions of statistics were drawn.

The most important premium accruing from this recuperation of the one through the many came with the probabilist's ability to elaborate a new and compelling science of what at the level of the individual could only appear to be pure chance. Once the whim of the individual had been integrated within the norms of the conglomerate, there emerged a knowledge that could present itself as the orderly and predictable working out of societal laws: "Statistical writers persuaded their contemporaries that systems consisting of numerous autonomous individuals can be studied at a higher level than that of the diverse atomic constituents. They taught them that such systems could be presumed to generate large-scale order and regularity which would be virtually unaffected by the caprice that seemed to prevail in the actions of the individual."[17]

The statisticians' "average man" also had a very definite doctrine to proclaim. The epitome of society as conglomerate, his perfect incarnation of the mean was such that all individuals, should they hope to understand anything of themselves, were obliged to ask how they compared with that universal standard. Consolidating one of the fundamental paradoxes of modern democracy, all could now be equal because all risked an equal insignificance should they cease to refer themselves to an exalted average that could, at the same time, claim to be nothing other than the mathematical summation of each as an individual. With all now equally subject to the rule of the average and the normal, the idea of a "census," of a one-by-one and one-for-one counting of the population, left the realm of the absurd. As Porter points out, "It makes no sense to count people if their common personhood is not seen as somehow more significant than their differences. The Old Regime saw not autonomous persons, but members of estates. They possessed not individual rights, but a maze of privileges, given by history, identified with nature, and inherited through birth. The social world was too intricately differentiated for a mere census to tell much about what really mattered" (25).

The individual consciousness posited by the science of statistics is no longer the practical, applied rationality of the early doctrine of chances, but the new thinking of a "mass man" hemmed in by and always receptive to the lessons to be drawn from a quantitative averaging of the one with the many. Probability theory offered the paradise of a purely present rationality freeing us from the burdens of history, family, and class. Its mutation into the imperial discipline of statistics redefined the individual as one unit cosubstantial with and quantifiable in terms of all others. Individual actions took on meaning only as a function of how they related to the actions of all others with whom the individual was compared.

Early probabilists such as Jakob Bernoulli, Leibniz, and De Moivre looked on their science as the beginning of a new apologetics, as a way of offering a rational defense of their Christian and providential world-views. For them, while the individual event may appear to be a product of chance, the working out of a divine plan for humankind could still be glimpsed in the broader contours of a whole into which the individual fit and for which providence pro-

vided the abiding law. In the course of the eighteenth and nineteenth centuries a profound mutation occurred. For Laplace, Quételet, and their progeny of sociologists, economists, and criminologists, the world was still deterministic, but it was a determinism cut off from any cause or principle of coherence beyond its material substance. For these scientists of the statistical, the world had become determined but meaningless.

The triumph of probability theory within the Enlightenment is important to our modernity for the boldness with which it was able to generate any number of rational and civic "moralities" whose control of the individual relied on an evacuation of all real reference to the individual and whose treatment of the specific demanded that it be subsumed within the general. For us, living in a time when the only conceivable ethics is one of what is probable within a context of large numbers, the eighteenth century holds a particular fascination as that moment when, perhaps forever, what began as an ethics of the individual freed from the weight of the past subordinated itself to the far more oppressive ideologies of the probable and the normal.

In examining the development of probability theory and its relation to the guiding ideals of the Enlightenment, we are inevitably led to ask what, finally, was at stake in this struggle to tame, domesticate, and render innocuous the brute reality of chance. The beginnings of an answer might be glimpsed in a 1777 text by Buffon entitled *Essai d'arithmétique morale.*[18] Buffon begins the explanation of his "moral arithmetic" by drawing a distinction between physical certitude and moral certitude. Physical certitude, he states, is the certainty we have of an event, such as the rising of the sun. Our certitude that the sun will rise is "physical" because it is "composée d'une immensité de probabilités" (458). Moral certitude, on the other hand, occurs when our certainty is only analogical and based on a comparison. Moral certitude is an only relative assurance based on similar situations and most often is derived from what has *not* happened in similar circumstances.

Conveying a clear sense of what he means by moral certitude is important to Buffon because, he insists, it is on its terms that we are forced to act in the greatest part of our lives. Struggling to clarify this concept, to the question where certitude begins, he offers a quantitative answer. A moral certitude, he decides, is one at least equivalent to our certainty that we will live another day. Relying on the primitive actuarial tables available during the period, Buffon then calculates that the probability that a man of fifty-six will die within the next twenty-four hours is approximately 1 in 10,189. This, for Buffon, provides exactly the benchmark he needs. Any event whose probability is less than 1 in 10,000 is one we can be morally certain will not occur and one to which we should accord no more real importance than we do to the possibility that we may die within the next twenty-four hours. Therefore, to cite Buffon's practical example, only a fool would invest in a lottery ticket when more than 10,000 other tickets are being sold. Like our death within twenty-four hours, the possibility of any event for which the odds are less than 10,000 to 1, he concludes, "should neither affect nor occupy our feelings or our minds for a single moment" (459).

It is the way man lives with but can and must forget his mortality that allows Buffon to clarify his crucial concept of the probable, of the morally certain. The fact that Buffon defines this category in terms of a customary dismissal of our death, which must one day be wrong, underlines a profound complicity between probability theory's concerted emasculation of chance and our own continual rejection from consciousness of any real sense of our impending death. In her study of classical probability theory, Lorraine Daston points out that while gambling problems continued to provide the most numerous applications for probability theory, an important part of the truly new discoveries within that science after 1700 occurred as a result

of attempts to establish what might be called an algebra of human mortality:

> This history of classical probability theory's treatment of risk is largely the history of mortality statistics and their applications. . . . Beginning with the work of Edmund Halley, Jakob Bernoulli, and Abraham De Moivre, the role of statistics in mathematical probability grew steadily, and for most of the eighteenth century the statistics of choice dealt with human mortality. Therefore, any account of the mathematical theory of risk in this period must begin with why, when, and how contemporaries kept track of death.[19]

Death was, it would seem, very much a silent player in the games of probability theory and the fascination they exercised over the eighteenth century. Jean d'Alembert, the one major mathematician of the period who remained skeptical of the more grandiose claims of probability theory, found himself caught up in and all but paralyzed by the same association of ideas as he wrote the article "Fortuit" for the *Encyclopédie.* He begins the entry with the Enlightenment's standard dismissal of chance and *le fortuit* as meaningless figments of our ignorance: "a fairly common term in our language and one completely bereft of meaning in nature. . . . We say that an event is fortuitous when its cause is unknown to us."[20] As he continues his analysis, however, the shadow of death and its links to chance and the fortuitous fall more and more heavily on his faith in the proud advance of human knowledge: "Anyone who reflects deeply on how events are related to each other will realize with terror to what extent our lives are fortuitous, and his thoughts will turn toward the idea of death as the single event freeing us from the universal servitude of living things" (2:63).

For d'Alembert as for Buffon, there is, consciously or unconsciously, a link between any meditation on chance, the less than certain, and the gamble of death. The truly fortuitous event, the event outside any causal chain through which we might control it, represents an unacceptable scandal in the same way that the reality of our own death, the ultimate unthinkability of that death, is antithetical to any true living of life. If probability theory was able so effectively to impose the illusion of its having tamed chance, of its having contained and mastered the threateningly uncertain within its mathematical equations, it was because in elaborating that utopia, probability theory turned our eyes away from that most terrifying gamble of all—our own death.

2

Gambling as Social Practice

Le marchand acquère, l'officier conserve,
le noble dissipe.
—A bourgeois of Lyon

But the age of chivalry is gone. That of sophisters, economists, and calculators, has succeeded; and the glory of Europe is extinguished forever.
—Edmund Burke, *Reflections on the Revolution in France*

Gambling gets no respect. Historians and literary critics of whatever persuasion have given it at best passing and condescending attention. Yet of all the social practices characterizing eighteenth-century France in its transition from *ancien régime* absolutism to revolution and democracy, few were more ubiquitous than gambling. King and court gambled. Rich and poor gambled. City dweller and peasant gambled. It is perhaps because gambling appears on both sides of the traditional cleavages through which we define the Enlightenment that it becomes all but invisible for those studying one group or another. In spite of the growing scholarly interest in the social and cultural dimensions of everyday life, no study has as yet seriously addressed what was actually at stake around the cards and dice always close at hand in the pockets and drawers of the eighteenth century.

To study gambling in *ancien régime* France is, in one sense, to study a new chapter in the history of the circulation of wealth and the increasingly ubiquitous phenomenon of money. Gambling, especially high-stakes gambling (a concept that waxes and wanes to accommodate every