

THE
HISTORY
OF GAMBLING

ROLL THE BONES

David G. Schwartz



GOTHAM BOOKS

2006

illegal gambling operations, and now gambling dollars transformed Las Vegas from a desert outpost into the world's number-one tourist destination today.

Packed with colorful characters from Julius Caesar to Casanova, George Washington to Steve Wynn, *Roll the Bones* is an all-in history of humanity's fascination with chance.



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Jacket design by Emily Mahon

Jacket photograph of Roman dice © Scala / Art Resource, NY

Jacket painting: Caravaggio (Michelangelo Merisi da) (1573-1610)

The Cardsharp (The Cheat with the Ace of Clubs), 1595-1596.

Oil on canvas, 94.5 x 128 cm. Kimbell Art Museum, Fort Worth, TX, U.S.A.

Photo Credit: Brian Lessing / Art Resource, NY

Taming Tyche

♦ ♦ ♦

THE SCIENCE OF CHANCE CREATES
PROFESSIONAL GAMBLING

The ancients lacked the mathematics to explain the parameters of chance. The dicers of the Roman Empire undoubtedly knew that they could expect the Venus throw less often than others but never developed any true theory of odds. Cicero wrote that a man who tossed a Venus throw twice in a row was the beneficiary of luck rather than the personal intervention of the goddess; he felt the need to advance this as an argument, not a generally accepted principle. With no understanding of probability, the ancients were at a loss to explain precisely what the likelihood of a certain dice-cast might be. It was a world brimming with fortune and fate, but without random chance.

The Greeks attempted to understand their luck only by appealing to Tyche, goddess of fortune. The Romans, with their supplications to Fortuna, did no better. It was not until the modern era that mathematicians began to seriously ponder the nature of chance. The fourteenth-century humanist Petrarch had an inkling that gambling was on the whole unprofitable, but for moral rather than mathematical reasons—a victory meant that someone else lost, and a winner today was sure to be a loser tomorrow. With the fuller elaboration of mathematics beginning in the sixteenth century, though, the mysteries of dice would be pierced and vague guesswork replaced by a thorough understanding of probability. Tyche would be tamed, and chance would become a science.

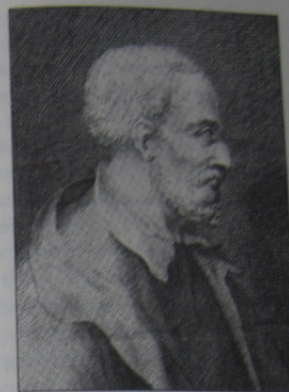
Armed with a better understanding of the odds and how to manipulate them, gamblers could become “professionals” and make a living from more or less honest games. Over the coming centuries, the idea of “mercantile” gambling would take root, and Europeans could gamble at casinos, take chances on lotteries, and bet on horses with odds set by professionals. Probability, by giving gamblers an appreciation of the nature of chance, made possible the

rise of mercantile, as opposed to social, gambling that would achieve explosive growth in Europe in the modern era.

The ascendancy of probability began with Girolamo Cardano, one of the first figures in gambling history whose life is known in vivid detail. His birth in Pavia, near Milan, in 1501 neatly symbolized the beginning of a new age in European science and life. Cardano earned fame for writings on popular science, medicine, mathematics, and ethics, what today would be termed "self-help." Cardano claimed that 131 of his books were printed during his lifetime, 111 were unpublished, and another 170 manuscripts he destroyed himself. To impress future generations with his importance, Cardano wrote an autobiography that spares no detail. With chapters on "My Manner of Walking and Talking," "Perils, Accidents, and Manifold, Diverse, and Persistent Treacheries," and "Things of Worth Which I Have Achieved in Various Studies," Cardano's *De Vita Propria Liber* (*The Book of My Life*) is as complete a portrait as we have of anyone from his era. If anything, Cardano provides too much information—most readers would probably rather not be familiar with his swollen left nipple. Nevertheless, Cardano's *Vita* preserves the intellect of one of his century's leading minds and sheds light on an important figure in the history of gambling.

Cardano's early life was tempestuous. His father, Fazio, was a respected Milanese scholar who studied law, medicine, and mathematics and for much of his life earned his keep teaching geometry to underprivileged boys. Fazio and Girolamo's mother, Chiara, were probably not married when Girolamo was born at Pavia (they weren't living together, in any event), but Cardano strenuously denied that he was illegitimate. Still, he admitted that his mother had tried to abort him by various means before his birth. His birth was apparently both uninvited and unwelcome.

After a sad, sickly childhood, the young man followed his father in studying medicine at the University of Pavia, though he transferred to Padua, where he distinguished himself in scholarly disputations, winning every public intellectual duel he entered, even besting faculty members. At times, he was no doubt as insufferable as any prodigy, and his prickly demeanor alienated many potential benefactors. Consequently, he spent several years in obscure poverty. But eventually his fortunes reversed and Cardano became one of the biggest celebrity scholars of the day. He contributed to several fields: In medicine, he developed an understanding of the causes and prevention of allergies and was the first to describe typhoid fever; he was the first to publish several algebraic innovations; he invented the combination lock and a mechanical shaft still used today. His talents as a physician were widely acclaimed—he



Girolamo Cardano (1501–1576) was one of the first to turn his fascination with gambling into a scientific study of the activity.

traveled as far as Scotland to render his expert opinion—and published prolifically, thus sharing his knowledge with a wider European audience.

Despite his material successes, he had a turbulent personal life. His favorite son, Giambatista, was executed in 1560 after he poisoned his wife, and his younger son Aldo became an unrepentant gambler and petty criminal who caused his father no end of heartache. Accused of heresy by the Church in 1570, Cardano was briefly imprisoned and stripped of his right to lecture publicly and to publish books. He ended his days in Rome, supplementing his own savings with a pension granted by Pope Gregory XIII—strange, considering he had been censured by the Church only a few years earlier.

He died on September 24, 1576, leaving an uneven legacy. Though popular in their own time with readers, his books were littered with errors and omissions, and his thorny pen bought him several detractors, whom he dutifully cataloged in one chapter of his autobiography. His belief in fantastic omens and superstitions led many later writers seduced by coldly rational empiricism to discount all of his work.

In the end, Cardano made a contribution to gambling that is no less important than his medical and mechanical improvements. Writing in the 1560s, he was the first to begin to explore the bounds of probability theory, the mathematics that would turn gambling into a profession and a science.

Though Cardano's manuscript remained unpublished for nearly a century, when other thinkers began to piece together a mathematical discourse on probability, his insights pointed toward the coming rationalization of chance. Even today, it gives valuable evidence of the state of Italian gambling in the sixteenth century.

This Renaissance man's theoretical contributions were driven by a keen personal interest in gambling that, at times, bordered on obsession. Cardano confessed as much in his autobiography when he said that he was so addicted to the chessboard and dicing table as to be "considered deserving of the severest censure." From his student years, Cardano gambled assiduously, stopping only when he became wealthy and famous. He played at dice for twenty-five years and at chess for more than forty, not on occasion, but every day, "with the loss at once of thought, of substance, and of time."

Cardano's reasons for gambling are frankly depressing. "It was not a love of gambling, but the odium of my estate and a desire to escape, which compelled me," Cardano wrote. In other words, he gambled because he was bored and miserable—a disheartening prospect for one of history's sharpest minds. In writing of his gambling, Cardano is deliberately ambiguous. At one point in his autobiography, he boasts of having made many friendships among the nobility through his gambling, then in the next sentence declares that his private affairs suffered because of it. It may have been regret over having instructed his sons in games of chance that drove him to later denounce gambling or, perhaps, looking back on his life after his censure by church authorities, he found it necessary to downplay his own luck in gambling for the purpose of moral correctness.

In any event, Cardano says, he gave up gambling without a second thought as soon as he gained a "respectable life," though he always maintained that for those with few other prospects, gambling was not such a bad thing. "In times of great anxiety and grief," he wrote, "it is considered to be not only allowable, but even beneficial." Those condemned to death or on a sickbed could freely gamble, Cardano emphasized, though even they should be sure to exercise moderation, not betting too much. For others, gambling was permissible, but not ideal. Reading or music would be more praiseworthy, as gambling set a bad example for one's children and servants and might excite anger or ignite a quarrel over money, "a thing which is disgraceful, dangerous, and prohibited by law." The ideal occasion of gambling took place rarely, for short periods and small stakes, such as at banquets or family gatherings. The ideal opponent was a king, prelate, distinguished character, or blood relative; Cardano discountenanced playing against professional gamblers as being both

disgraceful and dangerous: "You will be the loser because of their greater experience, trickery, and skill," he cautioned.

Cardano was something of a prodigy as a gambler. Whether this was because of his innate grasp of the odds and human psychology or because he might have cheated is left for his readers to deduce; Cardano certainly implied the former. Once, his gambling and temper led Cardano into rash dangled the former. Once, his gambling and temper led Cardano into rash danger. Losing in cards at the house of a senator in Venice, he realized that the deck was marked and that he was in the house of a professional cheat. Enraged, he impetuously slashed his adversary's face ("though not deeply") with his knife; he then attacked the servants and demanded to be let out of the house. The senator allowed him to escape, though Cardano's problems were not over. Stealthily fleeing the police, he fell into a canal and was rescued by the passengers of a passing skiff, who included the senator himself, his facial wounds still bound with a dressing. The senator remained mum about their earlier confrontation and appeared eager to get Cardano out of town as quickly—and silently—as possible. He nonchalantly bought Cardano a sailor suit and escorted the scholar as far as Padua.

Cardano combined his memories of practical gambling with his natural scientific inquisitiveness in the *Liber de Ludo Aleae* or *The Book on Games of Chance*. This manuscript, published only in 1663 (almost a century after his death), is a signal document in the history of probability, despite its shortcomings. It was written haphazardly, with chapters on the philosophy of luck, the ethics of play, and cheating alternating with mathematical studies of various probabilities. Even the math has its suspect moments—the manuscript was apparently a collection of hastily jotted notes, and as Cardano elaborated his earlier ideas, sometimes revising them, he often failed to delete his earlier misleading statements.

The *Liber de Ludo Aleae* was the first text published on the theory of probability and the first attempt to formulate general mathematical principles concerning random events. In chapter fourteen, when instructing his readers on combined points, Cardano stated his general law of wagers, that before agreeing to stakes one must consider the total number of outcomes and compare the number of casts that would produce a favorable outcome to those that are unfavorable. Only in this proportion, Cardano says, "can mutual wagers be laid so that one can contend on equal terms." Cardano's book on games of chance deserves recognition for this concept alone, which was revolutionary at the time and is still a working definition of basic probability. But he went farther, computing odds on the cast of one, two, and three

dice, on card games, including primero (which merited two chapters by itself), backgammon, and "games of the ancients," including the antediluvian astragali. Cardano also examined the division between games of skill and games of chance, noting that most card games join "the art of play" to pure luck.

As a both a ground-breaking work in the mechanics of chance and a chronicle of the state of play in the sixteenth century, one telling omission in the *Liber* might strike contemporary readers as odd: Cardano, it seems, has no conception of the house advantage, the key mathematical principle of most casino games today—the very foundation of professional gambling. Indeed, the scholar wrote that the most fundamental principle in gambling is equality: equal conditions for opponents, bystanders, money, and the tools of play. "To the extent to which you depart from that equality, if it is in your opponent's favor, you are a fool, and if it is in your own, you are unjust." Writing in the Renaissance, Cardano had no inkling of the coming revolution in gambling, which would see social games played among equals pushed to the side by professionally run bank games with stakes biased in the house's favor as the cost of the game.

Although Girolamo Cardano was a pioneer in the histories of both mathematics and gambling, he just missed out on the biggest change in gambling in its seven millennia of recorded existence. The idea that probabilities might let a professional legitimately offer all comers honest play and still make a profit would ultimately lead to the transformation of gambling from a scandalous social diversion to a legitimate profession.

Cardano's enunciation of the general law of probability, while the earliest documented foray into the subject, may have been only the visible tip of an iceberg of scholarly discussion respecting the calculation of probability in dice throwing. Though it is likely that both gamblers and mathematicians eagerly discussed the rules of probability, there are few surviving examples. Still, some of the period's greatest minds were harnessed in the effort to better determine the odds of various gambles. Between 1613 and 1623, for example, the path-breaking astronomer Galileo Galilei, probably at the behest of his patron, Grand Duke Cosimo II of Tuscany, wrote a fragment that revisits Cardano's consideration of the problem of the odds of three thrown dice.

Galileo, who is not known to have had any personal proclivity toward gambling, began "Sopra le Scoperte dei Dadi" ("Concerning an Investigation on Dice") by stating the obvious: When three dice are thrown, some numbers come up more commonly than others. To get a 3 or an 18, a gambler could only roll three aces or three sixes. While this seemed to be self-evident,

Galileo wrote that there still was some mystery: while 9 and 12 could be scored in just as many ways as 10 and 11, "long observation" made dice players consider 10 and 11 more advantageous, i.e., easier to roll, than nine and twelve.

To solve the problem, Galileo systematically expounded the rules of probability much as Cardano had. A fair six-sided die gave 6 equally likely outcomes, two dice 36 (six times six), and three dice 216 (six times six times six). But these 216 outcomes yielded only 16 combinations of points, 3 through 18. After elucidating the combinations with which various points could be thrown, Galileo drew up a table illustrating the chances of rolling points 3 through 10:

10	9	8	7	6	5	4	3
6,3,1	6,2,1	6,1,1	5,1,1	4,1,1	3,1,1	2,1,1	1,1,1
6,2,2	5,3,1	5,2,1	4,2,1	3,2,1	2,2,1		
5,4,1	5,2,2	4,3,1	3,3,1	2,2,2			
5,3,2	4,4,1	4,2,2	3,2,2				
4,4,2	4,3,2	3,3,2					
4,4,3	3,3,3						
27	25	21	15	10	6	3	1

In "Concerning an Investigation on Dice," Galileo drew up a table to demonstrate the probabilities combinations of three thrown dice. There were six different ways to roll the 6, 3, and 1 that total ten; three ways for 6, 2, and 2, etc. Adding up all of these probabilities, Galileo correctly surmised that there were 27 different rolls—out of 216 total possible outcomes—that would yield a result of 10.

He similarly deduced that 25 rolls could produce a 9, all the way down to a single roll (1, 1, 1) that would give a 3. To figure the numbers from 11 to 18, simply flip the table for 10 to 3: there are 27 ways to make an 11, and 1 chance for an 18.

Having given the mathematical probabilities for 3 through 10, Galileo concluded his didactic foray into dicing by remarking that, as these numbers totaled 108 chances, the remaining points (11 through 18) were merely an inversion of them. Thus, Galileo wrote, one could "very accurately measure all the advantages, however small they may be," of various rules of three-die games.

The mathematics behind Galileo's demonstration of dice probabilities was apparently well known before he wrote "Sopra le Scoperte Dei Dadi," and in the decades before he wrote the fragment, the revolutionary potential of probability became clear. The full implication of Galileo's math lesson—that there was a science to gambling—would transform the activity into a full-fledged business.

Previously, professional gamblers (who by definition derived their sole income from games of chance) consistently profited either through extraordinary luck—never a good bet—or through cheating others, which could be risky.

The elaboration of probability allowed for another path: using a discrepancy between the true odds and actual payouts to carve out a statistically guaranteed profit. This was the most significant change in all of gambling history and directly led to lotteries, bookmaking, and casinos. Thanks to a better understanding of probability, professional gamblers could now offer casual players the chance to bet as much as they liked against an impersonal vendor, with the "house odds" the irreducible price of entertainment.

For example, using Galileo's table above, one could go into business with three dice, a table, and a moderately sized bankroll. Paying out two hundred to one to any customer who rolls three aces seems an attractive offer. It is—for the banker. The customer will score the three aces only once out of every 216 rolls, thus leaving, in the tidy world of probabilities, a 15-unit profit for the gambling professional for every run of 216 rolls. This principle—the divide between the actual probability of various outcomes and the payouts offered to customers—allowed for the development of honestly run professional games of chance.

With the basic contours of probability well known by the middle of the seventeenth century, mathematicians moved on to more esoteric problems. One question that had been bedeviling scholars for centuries was the "problem of points." Fra Luca Paccioli, a Franciscan priest, mathematician, and friend of Leonardo da Vinci, first published the problem in 1494, though it may have been circulating in manuscript much earlier. The problem states that A and B are playing a best lot of eleven ball game, which will end when one of them has won six rounds. But they are forced to abandon play after A has won five rounds and B three. How are the stakes to be equitably divided? Cardano and his rival Niccolo "Tartaglia" Fontana (1499–1557) had offered solutions, but neither was correct. The question was fundamentally one of probabilities, and its proper solution would pave the way not only for probability theory, but for much of advanced mathematics. This major breakthrough took place in the correspondence of a parliamentary lawyer and a mathematician turned religious philosopher, correspondence that apparently began at the urging of a curious gambler.

The gambler was one Chevalier de Méré, who was himself a dabbler in mathematics. After approaching several Parisian geometers with the problem of points, in 1654 he turned to Blaise Pascal for a solution. Pascal had already established himself as one of Europe's leading mathematicians and scientists, with his theoretical contributions to geometry and the study of fluids, as well as his invention of the hydraulic press and syringe. Later, after a near-fatal accident, he would abandon his secular brilliance for religious contemplation inspired by

his Jansenist enthusiasms. Prompted by de Méré, Pascal began exchanging letters with Pierre de Fermat, a counselor with the Parliament of Toulouse today best remembered as the developer of calculus.

In a series of letters, the two mathematicians tackled the problem of points, in the process creating probability theory. First, they compared solutions concerning a die game in which a player attempted to roll a six with a single die in eight rolls. Pascal asked Fermat what the player should be given if he surrendered his fourth roll in return for a fair share of the stakes. Agreeing with Fermat's answer (one sixth of the stakes), Pascal moved to another problem: Two gamblers play until either has won three games, for stakes of 32 pistoles each. After the first player has won two games and the second one, they play a fourth game with the condition that if the first man wins, he gets all 64 pistoles. If the second triumphs, they are tied at two and each takes his original 32-pistole stake, should they balk on playing a fifth game. In such a case, the first player would gain either 64 pistoles for a game-four victory or 32 for a series-evening loss. According to Pascal, the equitable division of the stakes is 32 plus 16 (one half 32) pistoles, for a total of 48.

From here, Pascal introduces several permutations on the problem, stopping play after various combinations of games. Fermat replied with another method of solving the problem using different combinations, to which Pascal responded with a critique. In future correspondence, Fermat proved his methods undeniably sound, and together in these exchanges the two developed the groundwork for future work in probability.

Pascal also solved the problem of points in another manuscript (published in 1665, though written eleven years earlier) by using a construct known today as Pascal's triangle. Pascal did not invent this figure, which he called the arithmetical triangle and which was known in China as early as the fourteenth century. It is a method for using simple arithmetic to generate a table of binomial coefficients, something that can be very handy in calculating probabilities. Beginning with a 1 at the top, someone building the triangle has only to add the two terms above a space to get that space's value.

This table allows someone to quickly size up the odds of one out of several possibilities. What, for example, are the correct odds on coin flipping? With a fair coin, even schoolchildren know that it is an even chance, or one out of two, that a flipped coin will come up heads. This possibility is in the second line of the triangle: one divided by that line's sum of two. But what is the chance that four consecutive flips will all be heads? The fifth line of the triangle has the answer: one out of sixteen. In other words, there are sixteen total combinations of coin flips. In only one combination are all heads; in four ways,

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1
1 5 10 10 5 1
1 6 15 20 15 6 1
1 7 21 35 35 21 7 1
1 8 28 56 70 56 28 8 1
1 9 36 84 126 126 84 36 9 1

In the arithmetical triangle, each number is the sum of the two numbers immediately above it. Mathematician Blaise Pascal used the triangle, at the Chevalier de Méré's behest, to calculate the probabilities of winning a dice game.

there are three heads and one tails, and in six ways heads and tails are dead even. An absolutely square wager would pay odds of fifteen to one against all heads, according to binomial coefficients and Pascal's handy triangle.

The successors of Pascal and Fermat developed a thorough understanding of probabilities for more complex problems. Christiaan Huygens, a revolutionary Dutch astronomer and physicist who made several observational discoveries (including Saturn's moon Titan) also had a practical side epitomized by his invention of the pendulum clock. In this spirit, perhaps, and with the encouragement of Pascal, Huygens in 1657 published the first book on probability theory, *De Rationciniis in Aleae Ludo* (*On Reasoning in Games of Chance*).

De Rationciniis remained the chief work on probability until the first years of the eighteenth century. Pierre Rémond de Montmort, in his *Essai d'analyse sur les jeux de hazard* (*Analytical Essay on Games of Chance*), written in 1708, applied previous advances in probability to card games. In swinging scientific scrutiny onto such trivial pastimes, he wrote to banish superstition and replace it with a world governed by definite rules. By explaining the real math that governed games of chance, Montmort felt he might enlighten readers about "all those areas of life in which chance plays a role."

Montmort was not alone in advancing the frontiers of knowledge. Jakob Bernoulli, a Swiss mathematician, wrote *Ars Conjectandi* (*The Art of Conjecturing*), published in 1713, which pushed the science of probability farther, as did a Frenchman who lived in England, Abraham de Moivre, whose work, including *The Doctrine of Chances* (first published in 1718, though the definitive third edition was released posthumously in 1756), considered the problem of

points as well as several dice problems and problems involving multiple players. Aided by developments in calculus, the mathematics of probability was clearly maturing. With these advances, both independent professional gamblers and governments interested in issuing annuities and running lotteries to defray expenses now had a necessary theoretical foundation.

The spirit of wagers and probabilities was in the air in the seventeenth century as a gambling mania fastened itself on even the devout. Blaise Pascal used a gambling analogy after he had abandoned science for religious speculation. Casting about for an argument for the belief in God that could convince atheists left unmoved by centuries of theological speculation, Pascal hit upon the idea of deism as a calculated gamble. In short, "Pascal's wager" argues that belief in God is better than disbelief for purely utilitarian reasons grounded in probability theory. If one believed in God and God existed, the payoff was heaven, or infinite good. If one believed in God but no God existed, the believer gained nothing, just as an unbeliever would. But if someone professed nonbelief and God did in fact exist, the penalty was hell: infinite suffering. Thus, one who believed in God could hope for either unlimited good or nothing, while a nonbeliever might be subjected to eternal torment. In Pascal's eyes, this wager had only one logical choice: belief in God.

Not seriously intended as a theological argument for the belief in, much less existence of, God, Pascal's wager still shows how Europeans began to consider their world as a gamble with definite odds and payoffs. With a solid framework of mathematical probability and a proliferation of opportunities to gamble, this was hardly surprising.

That Cardano's manuscript on games remained mum on the principle of unequal stakes—the house edge—is even more perplexing given the fact that lotteries, a gambling form predicated on a payout incommensurate with the total stakes, were conducted in his lifetime, in his northern Italian homeland. Though his work opened the door for the later development of probability theory that would prove crucial to more sophisticated lotteries and gambling schemes, neither Cardano nor his mathematician successors talked much of lotteries. Instead, they worked diligently to solve problems of half-completed dice games and coin flips.

But lotteries were the truly revolutionary gambling form of the sixteenth and seventeenth centuries, the first genuine form of institutionalized mercantile gambling, or gambling as a business. The idea of lotteries was, of course, nothing new by this time. Many ancient cultures used randomizing elements, be it the casting of lots or the divining of goat entrails, to apportion land or duties. In the Roman Empire, both emperors and private citizens attempted

to boost their popularity by means of drawings for prizes. Sometimes, these "lotteries" took place at lavish banquets; it was custom for the hosts at Saturnalia to give out prizes to all who attended. The *missila*, or lucky items shot (with a slingshot) into the crowd at the Circus Maximus, were another sort of lottery. Banquet prize-giving survived the fall of the Roman Empire and flourished as late as the nineteenth century among the royalty of Europe, who regularly showered their courtiers with tickets that could be redeemed for toys or trinkets.

These prize drawings, though, lacked the most important feature of modern lotteries: the payment of a price or stake for a chance. Such a gambling scheme requires a densely populated urban area from which to draw sufficient ticket-buyers and, more importantly, an economy with readily circulating money. Modern lotteries first appeared instead in the Low Countries, particularly Flanders. At the time, Flanders was the most heavily industrialized area of northern Europe, possessed a flourishing economy, extensive trade, and a vibrant culture.

The earliest recorded evidence of lotteries comes from the city of L'Écluse, which in 1444 organized a lottery for the sake of raising funds for the repair of the city's walls and fortifications. With a grand prize of 300 florins, the lottery was advertised widely throughout the region—its promoters sent over 450 letters publicizing the draw to most of the major towns from Holland to Hainault. An earlier form of the lottery existed in Bruges, where it was a long-standing practice to fill vacancies in the office of the *scrooder*, who was in charge of wine-tasting and transport, by means of a random draw (in the ancient Roman tradition). To earn a chance at the *scrooder's* job, though, one had to pay a fee. To assuage the disappointment of *scrooder* also-rans, the organizers of the drawings began awarding cash prizes to runners-up. Throughout the early sixteenth century, lottery draws with prizes of money, gold, and jewelry became common throughout what is today Belgium, Holland, and northern France.

This kind of lottery is known today as a draw game, and its identifying characteristics are the drawing of a numbered (or personally signed, in early days) ticket from a container, variously called a wheel (though it did not spin) or box. In many countries, this remained the dominant lottery game into the twenty-first century. In Renaissance Flanders, these lotteries benefited churches and guilds, and, until their suppression by municipal authorities who wished to enter the lottery market (Bruges, for example, prohibited all "private" lotteries in 1561), spread throughout the region.

Italian merchants had been resident in the region since the end of the thirteenth century, and members of Italian colonies in Bruges were active as bankers, merchants, moneylenders, and pawnbrokers. The lottery made a quick transition to Italy: Soon, medieval northern Italian shopkeepers regularly supplemented their humdrum selling of goods with a random element. For a sum, a customer could draw from a lucky jar a ticket that entitled him to the article written on it. Before long, these shopkeepers were profiting more from their drawings than from their commerce. City authorities or the local nobles soon demanded a measure of consumer protection, attention to public welfare, and a piece of the action: They insisted that all drawings be rigorously inspected to ensure their honesty and that a portion of the profits go to either the needy poor or to the authorities themselves. With this transformation, the modern lottery was born, as here can be found two key elements of today's government-sanctioned lotteries—a supervisory commission and the redistribution of revenues for charitable purposes.

With the development of capitalist economies and an increased need for cash by governments and charitable institutions, lotteries truly began to flower in the sixteenth and seventeenth centuries, particularly in the developed urban centers of northern Italy. In 1522, a Venetian diarist wrote that a secondhand clothes dealer named Geronimo Bambarara had created "a new method of commerce" by offering a chance at carpets and money prizes for any who ventured an entry fee—at first only 20 soldi, then an entire ducat. Bambarara had created a monster. Before long, the entire Rialto district was filled with nothing but lottery hawkers and players, and the cash prizes had increased from 200 to 1,500 ducats.

City authorities soon moved to suppress these raucous draws and corner the lottery business themselves. The Venetian Republic began running its own lotteries with prizes of cash, merchandise, real estate, and even government offices, including the right to collect taxes and tolls. The proceeds went to the benefit of poor young women, assistance for the generally indigent, the redemption of hostage captives in foreign lands, and other noble endeavors. The sponsors of the new lottery also wished to offer a relatively benign form of gambling that had clear social utility, believing that if people were allowed a chance on this game, they would not play other, more pernicious games. But the lottery apparently only inflamed the gambling spirit, as nonlottery gambling merrily continued, and, by the division of expensive tickets into shares, lottery betting spread to the less affluent. Italian governments became dependent on lotteries and, wishing to maximize their revenues, forbade citizens from buying tickets in foreign lotteries, paid some salaries in part with

NEW YORK TIMES BESTSELLING AUTHOR

lottery tickets, and even made ticket purchases compulsory for guilds and other associations.

Venetians were long familiar with gambling. One historian has paralleled the risky nature of maritime commerce, the city's stock in trade, with the establishment of a gambling spirit, even conjecturing that when the seagoing trade started to diminish, Venetian nobles took up gambling with cards and dice out of habit. Gambling was certainly engrained into the culture of Venice; in 1229, for example, when an election to the office of doge (duke) ended in a tie, the two candidates decided the contest by a test of chance, possibly a toss of the dice. During Carnival season, which sometimes lasted from October to March, gambling was openly tolerated, and despite laws discouraging it, it flourished through the rest of the year as well.

The Venetian lottery, though it offered bettors a chance to score huge prizes, was hardly an exercise in instant gratification. Lottery drawings were drawn out, mind-numbingly anticlimactic, and tortuously efficient. Tickets were not numbered; each bettor instead wrote his or her name or personal motto on a slip of paper, which went into one urn. Into the other urn went slips of paper bearing the word *patientia*, patience, meaning "better luck tomorrow," or *precio*, prize, and a description of the prize won. Blindfolded charity boys selected winners by simultaneously drawing slips from each urn. The draw, which did not end until all tickets had been pulled and matched, could take as long as eleven days.

The Venetian version of the lottery quickly spread throughout Italy. The Genoese, not content merely to copy the Venetians, made substantial reforms in the lottery, spurred improbably by a change in election law. Each year, five new members of the ruling colleges were chosen by lot from a pool of candidates. In 1576, the doge of Genoa, Andrea Doria, designed a new system more in spirit with the age. Doria proposed assigning each of the 120 candidates a number, then simply drawing five numbers from an urn called the *seminario*. This new system of selecting candidates proved an efficient electoral reform and, as a public, random drawing, offered an excellent opportunity for a lottery. This electoral lottery became the basis for lotto-type games, which soon competed with draw lotteries.

Although betting on these election drawings was initially conducted on the sly, Genoa's authorities ultimately took a piece of the action for the public coffers. Nor did the Genoese see any point in keeping all of the fun of the election lottery for themselves: they sent lottery agents to towns throughout Europe, particularly Germany, to sell tickets and award prizes. Other Italian



Early lottery drawings on the Venetian model were solemn affairs. Two blind orphans simultaneously drew tickets from large "wheels." One represented the prize, the other the prizewinner, who wrote a name or motto on the slip. This engraving depicts a lottery drawn in Guildhall, London, in 1739.

principalities, such as Venice, Milan, and Naples, copied the Genoese lotto model in 1665, and for a while it flourished both in Italy and Germany, without much modification, though the number of possible numbers was reduced from 120 to 90 through the years. Surviving initial papal denunciations, the lottery won a new measure of legitimacy when the papacy permitted the establishment of a Roman lottery in 1732.

The original Genoese lottery lasted until the end of the eighteenth century in Germany, when most of the German states banned it, though lotto is alive and well in Italy, where a national lottery came in 1863, fast on the heels of Italian unification, and has continued into the twenty-first century.

Organized lotteries spread rapidly across Europe. Sometimes, this meant that Italians literally exported their lotteries, as the Genoese did in Germany, but other nations took the Italian lottery concept and made it their own. French lotteries have a history that rivals that of their Italian counterparts. King

Francis I authorized a French national draw lottery on the Venetian model as early as 1520. Francis bucked several centuries' worth of churchly denunciations of gambling when he boldly declared that if his subjects played the lottery, they would be too busy to fight each other and blaspheme God—ignoring the possibility that the lottery would give them only one more cause to argue and resent divine misfavor. After Francis's gambit, lotteries were sporadically conducted over the next century and a half for a variety of purposes. In 1656, a lottery raised funds for a stone bridge over the Seine in Paris, and four years later another was held for no other reason than to celebrate the nuptials of King Louis XV. In the eighteenth century, lotteries funded the construction of churches, including the structure that eventually became the Paris Panthéon, and other public buildings.

Like most others, the French lottery had a well-deserved reputation as a game with horrible odds. Most drawings, then and now, pay out less than half their gross earnings in prizes, meaning that the "house" holds more than fifty percent of all money—far worse than most casino games. But despite the odds, the indomitable house edge was not yet absolute. It is now a truism that those who make a living—or their operating budgets—from gambling never truly gamble, but while administrators were still grappling with the new science of probability, a clever man or woman had a fighting chance at beating the lottery.

One of the eighteenth century's greatest intellects and most magnetic personalities, the philosopher and writer Voltaire, undertook this very challenge. Born in 1694, the author of *Candide* cut a swath through French society, earning acclaim, exile, and, on more than one occasion, imprisonment in the Bastille with his candor and acid pen. In between writing satiric verse, authoring a controversial philosophical dictionary, and otherwise flouting authority, Voltaire was an avid gambler who preferred the card game of faro and *biribi*, an ancestor of roulette that allowed a gambler to guess which of thirty-six numbered balls a dealer would pull from a leather sack. Of gambling, Voltaire said, its law "alone admits of neither exception, relaxation, variation, nor human tyranny."

Returning to France from an English exile in late 1728, Voltaire was advised to keep a low profile, something that ran counter to his very nature. Instead of quietly biding his time, Voltaire met up with an old friend, Charles-Marie de La Condamine. La Condamine, a former army officer, was a mathematician with a definite sense of adventure—he would later become the first European to conduct a scientific exploration of the Amazon River—and exactly the kind of man Voltaire, living in France only at the sufferance of a monarch with finite patience, should have avoided. Adding fuel

to this already combustible mix was the fact that both Voltaire and La Condamine were financially pressed, and neither had a particularly strong inclination for hard work.

The pair soon found a royal opportunity to use their cunning to make a killing. On October 19, 1728, Louis XV's finance minister, Le Pelletier-Desforts, published a royal decree that outlined a new lottery projected to increase the attractiveness of Parisian municipal bonds, which were losing value daily. Under the royal lottery regulations, only holders of municipal bonds could purchase tickets; this privilege, Desforts hoped, would boost sales of bonds and retire Paris's municipal debt. On the eighth of each month, starting in January 1729, a lottery draw would be held; the lucky ticket owners would each win 1,000 francs.

All this seems relatively straightforward, but Desforts set rather strange conditions for the purchase of tickets: Bondholders could only buy them in proportion to the size of their bonds. Thus, the holder of a 100,000-franc bond paid 100 francs to buy a ticket, while the holder of a 1,000-franc bond paid just one franc. Under Desforts's lottery, both the 100-franc and 1-franc tickets had an equal chance of being drawn, and each paid off 1,000 francs. Studying the mechanics of the lottery, Voltaire and La Condamine concluded that if they could swamp the drawing with one-franc tickets, they would, according to the laws of probability, strike it rich.

Voltaire and La Condamine then organized a team of bondholders and did just that. In the February draw, La Condamine cashed in thirteen winning tickets for a total of 13,000 francs. Over the next few months, Voltaire's team dominated the lottery: In October, they won 1,004,000 out of 1,040,000 francs awarded. As Voltaire's winnings continued to mount, Minister Desforts, chagrined that his lottery was enriching the sly philosopher, attempted to curb the scheme by promulgating a decree restricting the sale of low-cost tickets. But La Condamine and Voltaire continued in their winning ways. The beleaguered finance minister then refused to pay Voltaire, but the philosopher successfully argued that he and his confederates had done nothing illegal, and that Desforts's own lack of mathematical acumen was hardly his fault. Though he was loath to do so, Desforts paid Voltaire and his team in full for all of their winnings. The lottery ended in June 1730; out of total prize money of 9,600,000 francs, Voltaire personally took home at least one million francs—enough to allow him to live comfortably for the rest of his life.

Voltaire and La Condamine's fiscal piracy slowed the government's reliance on the lottery; but as the French monarchy became increasingly strapped for capital, lotteries became more and more attractive. At first, they

continued to support charities. The Loterie des Enfants Trouvés (orphans) began in 1754, and a Loterie de la Pitié followed eight years later. In 1757, with the help of the extraordinary Venetian adventurer, notorious lover, and inveterate gambler Giacomo Casanova, the lottery finally became a regular fixture of French royal finance. Casanova, only lately removed from a Venetian prison, joined forces with a fellow Italian, Giovanni Antonio Calasbigi, to promote a Genoese-style lotto game as a funding source for the École Militaire, a new French military school. Using a solid foundation of probability theory and his personal charm, Casanova convinced the State Council to approve the new lottery. For their troubles, Calasbigi and Casanova were rewarded handsomely—Calasbigi became superintendent of the new Loterie de l'École Royale Militaire, and Casanova received six sales offices. Though he sold five of them for immediate money, he ran the sixth himself with the assistance of a clerk, making a fortune for himself.

Lottery drawings began in April 1758 and were initially held every other month, but in October they became monthly events. As in the Genoese original, drawings featured five numbered balls drawn from a "wheel" (actually a small cage) holding ninety. At first, players could bet on only one to three numbers, but eventually other options, including the selection of up to five numbers to be picked and betting on specific positions of winning numbers, became available. The lottery was immediately successful, and in 1776 King Louis XVI, perhaps at the urging of his new finance minister Jacques Necker, transformed it into the Loterie Royale de France and initiated twice-monthly drawings. The lottery was incredibly lucrative for the crown, contributing no less than 10 million francs to state coffers in 1788. Its chief attraction for most of its subscribers was the promise of instant wealth, which, in a time and place when equality of opportunity was nonexistent, might have been the only way for many players to escape backbreaking work and bitter poverty.

The Loterie survived the overthrow of the monarchy in 1789 but was outlawed in 1793, its profits already diminished by war and civil chaos. In 1797, the ruling Directoire reestablished the Loterie Nationale (sans, of course, the Royale). In this new incarnation, the lottery continued its previous winning ways, garnering annual revenues as high as 24 million francs and contributing an average of two percent of the state's budget each year. But critics argued, with increasing strength, that the lottery, which the poor played out of the desperate hope of a windfall, was in fact a regressive tax on those who could least afford it. French reformers succeeded, in 1836, in finally stopping the

lottery wheels from turning. Two years later they would effect a general prohibition of gambling throughout the country.

By this time, though, it was too late. The idea that chance could be tamed and turned to the aid of governments—or individuals—was nearly universal. The French would revive their lottery in the twentieth century, and even before that, they would have rivals for the title of Europe's most devoted gamblers. None would be as resolute as their cross-Channel rivals, the British.

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Daily Life in London in Times

began to slide in price throughout August. As with the *Compagnie des Indes*, public confidence in the South Sea Company evaporated, and by September the stock's value sank to £135 per share. Thousands of fortunes were lost in the crash, and the public demanded an investigation. Those responsible for the Company's rise were singled out for public censure and worse: The chancellor of the exchequer, John Aislabie, was expelled from the House of Commons and imprisoned in the Tower of London, and Company directors had varying portions of their estates confiscated.

The stock-buying public, though, learned little from all the excitement. The English gambling spirit remained irrepressible as investors sought the next "sure thing." One writer described Jonathan's, a coffeehouse near the royal exchange, as "being full of gamesters, with the same sharp, intent looks"—although these gamesters had turned in their cards and dice for stock in the Bank, East India, South Sea, and lottery tickets. Stock markets would eventually become legitimate foundations of mercantile capitalism, but as late as the nineteenth century they would be considered by the mainstream as little more than institutionalized bubbles.

Some likened stock speculation to a lottery. Indeed, by the time the British were chasing bubbles, lotteries were a national mainstay. The earliest known lottery conducted under the auspices of the English crown took place in 1569. This draw lottery, modeled closely on the Flemish/Venetian model, was organized directly on the order of Queen Elizabeth, and its promoters offered to the public four-hundred-thousand "lotts" (tickets), priced at ten shillings sterling each, which gave a chance at prizes of "ready money" and "certain sorts of merchandise." The queen had authorized this lottery for the express purpose of converting its excess revenues to "the reparations of the havens and strength of the realm, and towards other public good works." In this regard, it, like most lotteries, blended opportunities for personal enrichment (a chance at "ready money" and valuable merchandise) with civic responsibility (maintaining the kingdom's harbors and defenses).

Still, the royal lottery was not an easy sell, and it took two years to successfully complete it. Proclamations and advertisements urging public subscription to the lottery began appearing in 1567. Potential ticket buyers were urged to peruse the prizes at the sign of the Queen's Majesty's Arms, in the house of Mr. Dericke, the queen's personal jeweler. The lottery's organizers promised that it would contain "no blanks" and that each ticket buyer would win something.

According to the original plan, the organizers would sell 400,000 tickets at

ten shillings each, for a total of £200,000. The grand prize was to be worth a total of £5,000 sterling total: £2,000 in cash, £600 pounds in plate, and the remainder in "good tapestry, etc." After this lucky winner, smaller prizes would be paid to the next 29,999 holders of drawn lots. The remaining 370,000 speculators would get a half a crown for their troubles. Organizers hoped to have £100,000, after expenses, dedicated to the reparations of the harbors and other good works.

In the Venetian style, purchasers wrote "posies and devises," or epigrammatic mottoes, on their tickets. Many of these "posies" implored God or Fortune to grant a lucky draw: "My pose is small/But a good lot may fall"; "We put in one lot, poor maidens we be ten/We pray God send us a good lot, and that all we may say Amen"; and this humorous couplet: "I was begotten in Calice and born in Kent/God send me a good lot to pay my rent."

Despite a massive promotional blitz, the lottery was incredibly unsuccessful: Only one twelfth of the projected £200,000 worth of tickets were actually sold, so the value of prizes was diminished accordingly. The lottery organizers decided to duplicate every entry twelve times and, similar to the Venetian style, simultaneously draw names from one wheel and winning tickets and blanks from another. The drawing, held at the west door of St. Paul's Cathedral in London, took nearly four months to complete, even though it ran "day and night," lasting from January 11 to May 6.

Nearly twenty years passed before Elizabeth's administration launched another lottery. This one was considerably less ambitious. Like its predecessor, it was to be drawn at the west gate of St. Paul's, but took "only" three days to complete. Successfully conducted in June 1586 by one John Calthorp, the chief prize in this draw was a suit of "marvelous rich and beautiful armor." There were no other major public lotteries for years, though it is likely that, as in Venice, merchants held small lotteries to dispose of otherwise slow-moving merchandise.

Kings James I and Charles I, who reigned from 1603 to 1649, moved England even farther into the lottery business, granting a variety of charters for drawings. The earliest lotteries of this period were often run by foreigners, particularly Italians. In 1606, for example, James I granted the Italian merchant Julian Miccottie a license to auction some of his wares by means of a lottery; within four months, it had become so successful that municipal authorities complained that its "great clamor and tumult" was becoming a public nuisance.

Early efforts at colonization were like a lottery: Those who sailed knew that the journey would be risky, and investors shared the risk from home. If their ship arrived laden with spices or gold, they might make fortunes, but the

Baiting John Bull

BRITISH GAMBLING, 1750-1914

Losing their American empire didn't stop the Brits from gambling. In London, a city of nearly one million in the eighteenth century, cards and dice were played on nearly every corner. Thousands of ordinaries where men gambled assiduously after dinner each night could be found throughout the city. As a consequence, ordinaries became notorious haunts for loud gossip and fraudulent gambling. Specialized gaming houses competed with ordinaries by offering no-nonsense mercantile games.

In 1731, *Gentleman's Magazine* conducted a survey of gaming "halls" specializing in faro (derided as a "cheating game") that enumerated no fewer than eighteen classes of employees, yielding the impression that the hells consistently won enough to support such specialization. The commissioner, one of the proprietors, audited the books and supervised the director, who actually ran the gaming room. Operators dealt faro, while croupiers raked in the chips. Puffs and squibs (shills) were given money to play and thus encourage others, under the watchful eye of a clerk. An army of ushers, waiters, and porters catered to the gamblers' needs. Outside, lookouts and runners helped warn against police invasion; in the event they were unsuccessful, most houses retained lawyers, bail, and affidavit men. Players clearly entered at own their risk: Many houses retained a captain, whose job was "to fight any gentleman who might be peevish about losing his money," a dunner, who recovered money lost at play, and "ruffians, bravos, and assassins," whose responsibilities can only be imagined.

These clubs offered credit and operated in constant fear of the police, necessitating several additional employees and making them even less apt to give players an honest chance—it would have been impossible to support this army of employees on the slim proceeds guaranteed by the honest house advantage. As the predations of the gaming houses grew more persistent, the public became agitated against them. The *Grub Street Journal* in 1736 printed

a letter warning against puffs who induced new arrivals to London into gambling at crooked houses. Many gaming houses, play migrated to taverns and coffeehouses, presumably more refined and intellectually stimulating establishments. In the 1740s, as reflected in the burst of antigambling legislation that had ended serious gambling at Bath, open gambling came under attack, and urban gambling survived only where it could find protective cover.

Coffee- and chocolate houses of this time, unlike their modern counterparts, were more than places to grab quick refreshment or meet for a safe first date. At least two thousand of them could be found in London in the early eighteenth century, and each was the gathering place for a particular trade, profession, class, party, or nationality. Whigs and Tories, Scotsmen and Frenchmen, insurers and stockjobbers, all had their own coffeehouses. Once a coffeehouse established itself with a sufficient number of like-minded customers, it was a small step to turn the place into a club by instituting a membership charge and barring all outsiders. In addition to providing a fine place for jolly fraternization, it also provided a legitimate cover for clandestine gambling among members. The first of these, White's, opened in 1697 on St. James's Street, followed by the Cocoa-tree (just a few doors down) in 1746. In the 1760s, a host of new clubs opened nearby, leading the statesman and author Sir George Otto Trevelyan to liken St. James's Street to one vast casino.

Though no club existed solely as a gambling house, some were better known for gambling than others. In the late eighteenth century, White's, Almack's (which became Brooke's in the 1760s), Graham's, and the Cocoa-tree Club (all originally chocolate houses) were the most notorious for their gambling. In general, upper-class gambling clubs predominated in and around St. James's Street and Piccadilly in the West End. White's in particular was infamous: Faro and hazard could be played there into the late hours. Professional gamblers, provided they were not proven cheats, were happily admitted. Players who indulged in social games like chess, checkers, and backgammon had to pay a small fee to the club; such fees remained common in houses allowing social gambling. The club's members bet on everything from birth to death were memorialized. Because of its gambling, White's acquired something of a bad reputation and was believed to be the haunt of highwaymen, waiting patiently for the night's biggest winner to leave so that they could harvest his winnings.

According to legend, White's was the birthplace in 1765 of one of the most widely traveled of England's culinary creations, when John Montagu,

he was no amateur. Backed by investors, he took \$10,000 to Las Vegas and put his system into action. He successfully doubled his bankroll, though casinos, suddenly wary of his winning ways, inaugurated disruptive tactics, including constant reshuffling and possibly, in one instance, a cheating dealer.

When Thorp published his system and an account of his winning field test in *Beat the Dealer* (1962), card counting became an instant phenomenon. A variety of systems soon emerged; everyone with access to a computer claimed to have developed a new, improved, guaranteed method for beating casino blackjack. Most of these were variations on Thorp's basic premise, tracking high- and low-value cards. The simplest system requires the player to give low cards (2, 3, 4, 5, 6) a value of +1, ten-value cards and aces a value of -1, and 7s, 8s, and 9s zero value. When the count is high, a player is more likely to win and should bet accordingly.

Though feasible, card counting was not foolproof. Many who tried to master counting simply lacked the concentration and quick recall necessary. In addition, casinos could easily thwart counters by arbitrarily reshuffling the cards or simply barring suspected "skill" players. Though, as places of public accommodation, casinos are forbidden to discriminate based on race, gender, handicap, or nationality, as private businesses they are allowed to refuse service at will. Thus, even though they might have a foolproof system, the deck was usually stacked against counters.

Despite the unfavorable odds, many would-be casino beaters were entranced by the mathematical certainty of winning that the card counting, if done correctly, promised. In order to frustrate casino countermeasures and to allow bigger bets by starting with a larger bankroll, team play emerged in the

early 1970s. Its most famous exponent was Ken Uston, a math prodigy, Harvard MBA, and former vice president of the Pacific Stock Exchange, who, like many others, became interested in blackjack after reading *Beat the Dealer*.

In March 1974, Al Francesco, leader of a San Francisco-based blackjack team, recruited Uston. The team made money by a simple division of labor. On a typical night, it sent several card counters into a casino; each of them bet the table minimum and, using an "advanced point count" system, quietly kept track of the table's favorability. When the player's edge was strong enough, using a series of prearranged signals the counter would call over the B.P. (Big Player), who would then bet the table limit. The system worked until casino surveillance started to recognize the players' teamwork. Then, players adopted disguises and otherwise attempted to outwit casino managers, surveillance teams, and independent consultants hired to combat skill play. When he went public with his role as a "Big Player," Uston became a blackjack celebrity. Claiming to have made millions from blackjack tables in Nevada and Atlantic City, he was ultimately barred from nearly every casino in the country. He fought unsuccessfully to challenge his banishment before his death in 1987 at the age of fifty-two.

Though blackjack lost a true original with the passing of the flamboyant Uston, the idea of team play remained. The most famous blackjack team since Uston's group is the MIT card-counting team. There have actually been several counting groups affiliated with that prestigious university, but they remained relatively obscure until the 2002 book *Bringing Down the House*, in which Ben Mezrich told the story of "Kevin Lewis," a member of the early to mid-1990s edition of the team who spoke of millions of dollars in profits. Though the story was hardly revolutionary, it introduced a new generation of young players to the thrill of team play, and may have contributed to a boom in blackjack play among younger casino patrons.

As the popularity of Las Vegas soared, casinos became paradoxically both

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