PART ONE

# THE FIBONACCI NUMBERS

CHAPTER 1

# Historical Background

Born around 1170 into the Bonacci family of Pisa, Leonardo of Pisa was the son of the prosperous merchant Guglielmo, who sought to have his son follow in his footsteps. Therefore, when Guglielmo was appointed the customs collector for the Algerian city of Bugia (now Bejaia), around 1190, he brought Leonardo with him. It was here that the young man studied with a Muslim schoolmaster who introduced him to the Hindu-Arabic system of enumeration along with Hindu-Arabic methods of computation. Then, as he continued his life in the mercantile business, Leonardo found himself traveling to Constantinople, Egypt, France, Greece, Rome, and Syria, where he continued to investigate the various arithmetic systems then being used. Consequently, upon returning home to Pisa around 1200, Leonardo found himself an advocate of the elegant simplicity and practical advantage of the Hindu-Arabic number system—especially, when compared with the Roman numeral system then being used in Italy. As a result, by the time of his death in about 1240, Italian merchants started to recognize the value of the Hindu-Arabic number system and gradually began to use it for business transactions. By the end of the sixteenth century, most of Europe had adjusted to the system.

In 1202, Leonardo published his pioneering masterpiece, the *Liber Abaci* (*The Book of Calculation* or *The Book of the Abacus*). Therein he introduced the Hindu-Arabic number system and arithmetic algorithms to the continent of Europe. Leonardo started his work with the introduction of the Hindu-Arabic numerals: the nine Hindu figures 1, 2, 3, 4, 5, 6, 7, 8, 9, along with the figure 0, which the Arabs called "zephirum" (cipher). Then he addressed the issue of a place value system for the integers. As the text progresses, various types of problems are addressed, including one type on determinate and indeterminate linear systems of equations in more than two unknowns, and another on perfect numbers (that is, a positive integer whose value equals the sum of the values of all of its divisors less than itself—for example, $6 = 1 + 2 + 3$ and $28 = 1 + 2 + 4 + 7 + 14$). Inconspicuously tucked away between these two types of problems lies the one problem that so many students and teachers of mathematics seem to know about—the notorious "Problem of the Rabbits."

*Fibonacci and Catalan Numbers: An Introduction*, First Edition. Ralph P. Grimaldi.

Before continuing at this point, let us mention that although Leonardo is best known for the *Liber Abaci*, he also published three other prominent works. The *Practica Geometriae* (*Practice of Geometry*) was written in 1220. The *Flos* (*Flower* or *Blossom*) was published in 1225, as was the *Liber Quadratorum* (*The Book of Square Numbers*). The latter work established Leonardo as a renowned number theorist.