

# Introduction

WELCOME TO THE SEVENTH VOLUME of *What's Happening in the Mathematical Sciences*. Once again, it showcases the remarkable vitality of mathematics. Reading the articles in the book, you may be amazed by how much has happened in mathematics in the short time that has passed since the previous volume appeared.

One of the recurring features of the achievements described in the book is that major discoveries are often made where two or more well-established mathematical disciplines overlap. For example, in “A New Twist in Knot Theory,” modular knots, which are already a mix of number theory and topology, are shown to be the same as knots that appear in dynamical systems and which are related to the chaotic behavior that makes precise weather prediction impossible. “Error-term Roulette and the Sato-Tate Conjecture” describes the delicate interplay between probability, which is inherently random, and number theory, which is traditionally deterministic and precise. “Dominos, Anyone?” connects the finitary discrete area of combinatorics with statistical mechanics and differential equations—disciplines that are infinitary and continuous. Mathematics and applications have had some extraordinary developments recently. “Not Seeing is Believing” shows how the dream of H.G. Wells depicted in *The Invisible Man* can come true and why the director of the next movie version should seek the help of mathematicians, as well as special effects artists. “The Fifty-one Percent Solution” describes the startling discovery that coin tossing is not a perfect model of randomness. Another surprising result, explained in “Compressed Sensing Makes Every Pixel Count,” is that one can (and sometimes *should*) replace a 10 mega-pixel camera with a 30 kilo-pixel device, or even a one-pixel device.

Two articles touch upon further achievement in established mathematical areas. “Getting with the (Mori) Program” explains how the major obstacles to constructing the simplest (minimal) models of algebraic varieties of dimension three and higher have been removed. “Charting a 248-dimensional World” tells a fascinating story of how a large group of specialists in Lie theory, scattered all around the world, cooperated to uncover the buried structure of the Lie group  $E_8$ , one of the most complicated algebraic objects of its kind.

The techniques of CSI crime labs and particle physicists’ linear accelerators come together to solve the mystery of “The Book that Time Couldn’t Erase.” This is the story of what is known as the Archimedes Palimpsest, a 13th century copy of the original text of Archimedes, which now opens a new link to the mind of the great mathematician of ancient Greece.

All in all, we hope that when you finish reading the book you share the excitement we find in the vibrant, active science of mathematics. And, most of all, we hope you enjoy reading it.

Sergei Gelfand, Publisher  
Edward Dunne, Editor

