Editorial

N Mukunda, Chief Editor

When Isaac Newton acknowledged his debt to his predecessors by saying he had been able to see farther because he stood on the shoulders of giants, he had in mind principally Galileo Galilei and Johannes Kepler. From the former he inherited the foundations of mechanics distilled from careful terrestrial experiments, and upon which he built his own magnificent "system of the world" based on his law of universal gravitation. From the latter he inherited the three fundamental laws of planetary motion, known after Kepler's name. These laws concern respectively the elliptical shape of each planetary orbit; the constancy of the areal velocity; and the connection between time period and orbit size when different planets are compared with one another. Kepler discovered his laws by painstaking analysis of the astronomical data compiled by Tycho Brahe before him; this lasted many years, and the sequence of their discoveries is in fact not the same as their numbering. Incidentally in the case of the third law, there was a gap of several years between discovery and announcement — something unimaginable in today's intensely competitive scientific world!

Sometime before all this, however, Kepler had convinced himself that there was a "divine connection" between the sizes of the planetary orbits and the five regular polyhedra known since Greek times. This was his picture of the heavens of his time, "a harmony of the spheres", and is what is reproduced on the front cover. The orbits of successive planets were enclosed in a sequence of these solid figures in nested fashion; this "truth" had come to him in a flash while teaching mathematics class at school. Amazingly this construction gave a pretty good fit to the data then available to him!

About Sonya Kovalevskaya

"An early indication of her talents was her ability to make sense of the sine function all by herself."

"Her thesis contained results on degenerate Abelian integrals which reduced to elliptic integrals, and on the shape of Saturn's rings."

Our excuse for presenting Kepler's construction is an article by Thanu Padmanabhan describing a velocity space treatment of the Kepler problem — the motion of a body in a central inverse square law of force. While this is to be found in some text books, it is not too widely known and appreciated. Padmanabhan's article should be of interest to students and teachers alike for its pedagogical level and attractive style. The many miracles of the inverse square force law — including the reason for and existence of an unexpected constant of motion — are beautifully explained.

This problem reappears in quantum mechanics as the "Coulomb problem" — with the inverse square law of force being electrostatic in origin. It will interest readers to realize that the same miracles played an important historic role again in the development of the new mechanics. After Heisenberg's discovery of matrix mechanics in summer 1925, and before the advent in early 1962 of Schrodinger's wave mechanics based on the more familiar mathematics of partial differential equations, Pauli solved the Coulomb problem algebraically exploiting its unusual constant of motion. This was a triumph for the new ideas ushered in by Heisenberg.

Turning to the back cover, for the first time we feature a woman — something we hope to do regularly — the remarkably talented mathematician Sonya Kovalevskaya. In a brief article-in-a-box, Mythily Ramaswamy describes her life and carreer in mathematics, the turbulent times she lived in and the prejudices she had to contend with both on the social and the professional fronts. That she was able nevertheless to produce work of the highest calibre in mathematics, and also turn to literary pursuits, speaks both for her talents and strength of character.

One may say "The eternal mystery of the world is its comprehensibility." It is one of the great realizations of Immanuel Kant that the postulation of a real external world would be senseless without this comprehensibility.

— Albert Einstein