STALKING THE REIMANN HYPOTHESIS

The Quest To Find The Hidden Law of Primes

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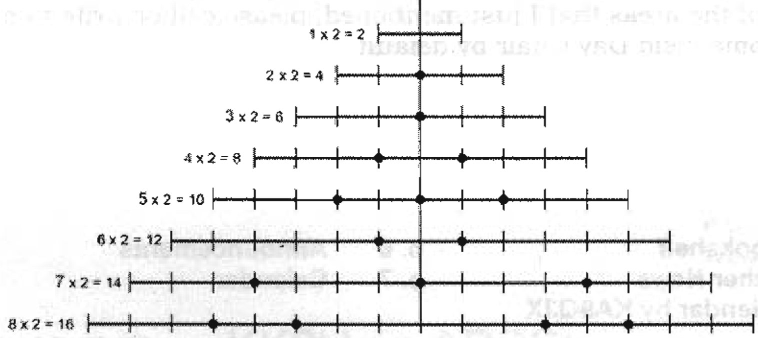
I begin this review with a caveat that I did not understand much of the book's contents and that, unless you are a professional mathematician, it is unlikely that you will. Nevertheless, I strongly recommend *Stalking The Reimann Hypothesis* for two reasons; namely, it 1) provides interesting insight into how a purely mathematical quest to understand the nature of prime numbers morphed into solutions for significant problems in physics, economics, politics and other fields, and 2) describes some of the lives of mathematicians who participated (and are participating) in the quest to solve find the *Hidden Law of Primes*. And –by the way, it provides a head-start if you are interested in developing a proof for the *Reimann Hypothesis* that will make you eligible to win a Million Dollar prize.

A *prime number* is a *natural* number (integers *1, 2, 3, ... 10, 11, 12 ...*) that is evenly divisible only by *1* and itself. Examples of the first few prime numbers are *1, 2, 3, 5, 7, 11, 13, 17, 19, 23* and so on. One question that could be asked is *Are there a finite or an infinite number of primes?* If there are only a finite number of primes, then *What is the largest prime number?* If there are an infinite number of primes then, *What is the distribution of prime numbers so we may know where to look for them?* The *Reimann Hypothesis* (Bernhard Reimann, 1826-1866) starts with an assumption that there are an infinite number of primes and that their *zeta zeros* (a complex number having real and imaginary parts obtained from calculation of a transform or mapping function) all lie on a *critical line* in a complex plane in which the *real* part has a value of one-half. Riemann died early without providing any proof or insight into how he formulated his hypothesis. At this point, you are no doubt asking *Who cares?* One answer is that mathematicians care. Another is cryptographers. And, if you read this book and understand even a part of it, you will care.



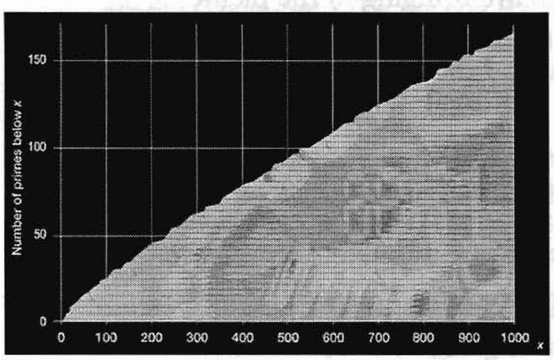
Many mathematicians devised systems to explore patterns of distribution of prime numbers. Here is the Goldbach Weave. The double of prime numbers are found along the central vertical axis, derived from Goldbach partitions. See www.andywardley.com/misc/goldbach.html

Eratosthenes

The modern search for primes begins with Greek mathematician and philosopher Eratosthenes (c. 276 – 194 B.C.E.), who among other achievements calculated the circumference of Earth at 24,660 miles (only 241 miles shy of its current value). He developed a *sieve test* for identifying primes. Euclid (of geometry fame) then offered a proof for the proposition that there are an infinite number of primes. The challenge was then set to determine the distribution of prime numbers amongst natural numbers. The author takes us through paths carved out by great mathematicians whose names are familiar to engineering, science and mathematics students including Legendre, Gauss, Euler, Dirichlet, Stieltjes, Hilbert, Landau, Harald Bohr (brother of Niels Bohr), Skewes, Cramér, Siegel, Hadamard, Selberg, Schwartz, Weil, Nash and others.

In 1974 at Princeton's Institute of Advanced Studies, mathematician Hugh Montgomery and physicist Freeman Dyson would have a chance encounter that set the direction of research on the *Reimann Hypothesis* to the present day. Montgomery began to explain his recent results on *pair correlation* and Dyson, who was working on a theory of Quantum Electrodynamics (QED) developed by Feynman, stopped him and asked *Did you get this?* Montgomery had and in that instant understanding of the *Reimann Hypothesis* and primes merged with understanding of nuclear physics.

(Editor's note: Montgomery told Dyson of his function of distribution of zeroes of the zeta function of Riemann [see below]; Dyson told Montgomery that the function was identical to that of a function used in quantum physics that Shel is referring to, called the density of the pair correlation of eigenvalues of random matrices in the Gaussium Unitary Ensemble. In recent quantum experiments, the spectral distribution of energy given off by exciting some heavy nuclei is identical to that for some stretches of zeroes for the Riemann zeta function).



Number of primes below x - is there a trend?

The Riemann zeta function

$$\zeta(n) = 1 + \frac{1}{2^n} + \frac{1}{3^n} + \frac{1}{4^n} + \ldots = \frac{2^n}{2^n-1}\,\frac{3^n}{3^n-1}\,\frac{5^n}{5^n-1}\,\frac{7^n}{7^n-1}\,\frac{11^n}{11^n-1}\ldots$$

See www.timetoeternity.com/time_space_light/prime_time.htm

The book concludes with brief descriptions of how the merger of Montgomery's and Dyson's knowledge generated discoveries in a wide range of technologies including statistics and computer science as well as brief biographies of mathematicians and scientists who continue their searches to this day for a proof for the *Reimann Hypothesis* – one of the most important problems in mathematics. In my opinion, the book is well worth your time and effort – if only for the history and biographies of the main participants.

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