• **Mathematics by analogy**

  • Evolution

  • J. J Sylvester’s molecules (1870)

  • Catastrophe Theory

  • Deterministic Chaos (March 24, “Fractal Friday”)

  • Simulated Annealing

  • Genetic Algorithms

  • DNA Computing

  • Quantum Computers
Two final provocative views:


“It is very time consuming to solve a system of linear equations with symbolic coefficients. By plugging in specific values for n and other parameters if present, one gets a system with numerical coefficients, which is much faster to handle. Since it is unlikely that a random system of inhomogeneous linear equations with more equations than unknowns can be solved, the solvability of the system for a number of special values of n and the other parameters is a very good indication that the identity is indeed true.

It is a waste of money to get absolute certainty, unless the conjectured identity in question is known to imply the Riemann Hypothesis.”

Goldbach’s conjecture (1742): every even number is the sum of two primes.
Abstract of the future. We show in a certain precise sense that the Goldbach conjecture is true with probability larger than 0.99999 and that its complete truth could be determined with a budget of 10 billion.

“Using software written in Mathematica that runs on an IBM RS/6000 workstation, I constructed a perverse 200-page algebraic equation with a parameter N and 17,000 unknowns:

\[ \text{LeftHandSide}(N) = \text{RightHandSide}(N). \]

For each whole-number value of the parameter N, ask whether this equation has a finite or an infinite number of whole number solutions. The answers escape the power of mathematical reason because they are completely random and accidental. This work is an extension of famous results of Gödel and Turing using ideas from a new field called algorithmic information theory.

I believe that elementary number theory and the rest of mathematics should be pursued more in the spirit of experimental science, and that you should be willing to adopt new principles. I believe that
Euclid’s statement that an axiom is a self-evident truth is a big mistake.

The Schrödinger equation certainly isn’t a self-evident truth! And the Riemann hypothesis isn’t self-evident either, but it’s very useful. A physicist would say that there is ample experimental evidence for the Riemann hypothesis and would go ahead and take it as a working assumption.

*What is the Riemann hypothesis?* There are many unsolved questions involving the distribution of the prime numbers that can be settled if you assume the Riemann hypothesis. Using computers people check these conjectures and they work beautifully. They’re neat formulas but nobody can prove them. A lot of them follow from the Riemann hypothesis. To a physicist this would be enough: It’s useful, it explains a lot of data. Of course a physicist then has to be prepared to say “Oh oh, I goofed!” because an experiment can subsequently contradict a theory. This happens very often. In particle
physics you throw up theories all the time and most of them quickly die. But mathematicians don’t like to have to backpedal. But if you play it safe, the problem is that you may be losing out, and I believe you are.”
• My own view:

“Mathematics is ultimately about highly reliable mathematical knowledge. Proof and experiment, introspection and computation, probability and certainty will co-exist in varying balance.

But, without serious discussion of the changes underway, we will lose the benefits of our tradition without reaping the rewards of the new regime.

“It is true because Von Neumann, Maple or Mathematica says so...”

is the likely and unsatisfactory consequence of inattention.”