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Chaos, and what to do about it

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Nature is rich in phenomena governed by simple deterministic laws whose long-time dynamics is complex beyond belief. A century ago Poincaré, mulling over his newly discovered homoclinic tangles, mused that "the complexity of this figure will be striking, and I shall not even try to draw it". How are we to think about such worlds where the center cannot hold, things fall apart, every path we take is unstable?

Today the theory of chaotic systems ranks in beauty and depth amongst the crown jewels of theoretical physics. The theory probably answers not a single one of the questions that started this quest - we still do not know whether the solar system is stable, what is turbulence, or how to prove the Riemann conjecture. It's been a surprise all along. Theory developed for counting moths has been verified in fluid helium and palpitations of chicken hearts. Studies of conductance fluctuations in mesoscopic devices have uncovered new relations among Riemann zeros. Difficult path integrals together with easy pinball games lead to a quantization of helium, thus solving the very problem that killed the old quantum theory.

The talk will offer a glimpse into this newly charted territory.