

**I**T IS POPULAR TO SAY that top quarks were produced in great numbers in the fiery cauldron of the Big Bang, disintegrated in the merest fraction of a second, and vanished from the scene until my colleagues learned to create them in the Tevatron, a giant particle accelerator near Chicago. That would be reason enough to care about top: to learn how it helped sow the seeds for the primordial universe that evolved into our world of diversity and change. But it is not the whole story; it invests the top quark with a remoteness that veils its real importance—and it denies the immediacy of particle physics.

**T**HE REAL WONDER is that here and now, every minute of every day, the top quark affects the world around us. Through the uncertainty principle of quantum mechanics, top quarks and antiquarks wink in and out of an ephemeral presence in our world. Though they appear virtually, fleetingly, on borrowed time, top quarks have real effects.

**A** FEW NUMBERS regulate the dimensions and character of the everyday world, from the size of atoms to the energy output of the sun. Only a generation ago, these parameters of the quotidian—the mass of the proton, the mass of the electron, and the strengths of a few fundamental forces—seemed givens, beyond the compass of science. Today, we have begun to discern links among them, to see how each of them might be understood and, eventually, computed.

**T**HE PROTON, the basic unit of the atomic nucleus of all the elements, is itself composed of up quarks and down quarks. We have discovered that the proton's mass is due mostly to the energy stored up in the "strong" force that holds the quarks together. By studying the force between quarks, we learn why the proton is the way it is.

**W**E NOW BELIEVE that all the subatomic forces have equal strengths at very high energies. We perceive distinct strong, weak, and electromagnetic interactions because the symmetry—the perfection—that is evident at high temperatures is hidden in our low-energy world. Everything that happens from very high temperatures down to low temperatures is encoded in the way the forces evolve from the state of perfection to the state of nature.

**S**INCE TOP STANDS APART as very much heavier than the others, it has a special influence on the evolution of the strong force, and so on the mass of the proton. If top weighed a bit more or less, the force that confines quarks inside a proton would be slightly stronger or weaker. The resulting change in the proton's mass would give our world a different character. The top quark's mass is expressed in the form of every flower and grain of sand, in every human face.

## TOP MATTERS!

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