centration of a key component of the complement system to a level that could start a damaging immune reaction.

Cichon notes that Gelsinger was known to have "suffered a chest infection some time before the trial," so his complement system might have been sensitized already. In the bloodstream, the proteins of the virus coat would combine with antibodies, forming complexes that activate the complement system. This can cause inflammation in the vessel walls of liver, lungs, and kidney, and ultimately multiple organ failure. "Exactly the same symptoms were observed in the case of Gelsinger," says Cichon.

Gene therapist Prem Seth of Des Moines University in Iowa thinks that complement activation could indeed cause some of the adverse reactions observed in gene therapy trials with adenovirus vectors. Several years ago, he observed that the coat proteins of the virus initiate a strong immune response in human blood. "I have always argued that the virus should only be applied locally, not into the bloodstream," he told *Science*. And he agrees with Cichon that complement activation should be measured in blood samples to see if the test can predict which patients are likely to suffer strong adverse reactions. "All patients should be screened for their complement response," he says. "It is an easy test."

Phil Noguchi, director of the Food and Drug Administration (FDA) division for gene therapy, agrees that this finding is "a new piece in the puzzle" but emphasizes that the fatal trial probably had "multiple sources." He says that the FDA is considering how to use a complement-sensitivity test in gene therapy trials. **–ADAM BOSTANCI**

EXTRASOLAR PLANETOLOGY

Jupiters Like Our Own Await Planet Hunters

Astronomers have had plenty of luck lately finding planets circling other stars. But they've had no guarantees that the greatest prizes—planetary systems like our own, with a potential for life—are out there to be found. Due to limitations of the searches so far, the 77 newly discovered extrasolar planets either are gas giants orbiting much closer to their stars than Jupiter or are far more massive than Jupiter. No one can yet detect the most prominent hallmark of our solar system: planets resembling Jupiter in mass (at 70% of the solar system's total planetary mass) and in orbital distance (five times Earth's). But two new studies—one extrapolating from the oddball planets discovered so far and another modeling the way planetary systems form—give added hope that systems like ours are out there in abundance. Astronomers could start finding Jupiter-like exoplanets within a few years (also see p. 616).

Astronomers have found 77 exoplanets so far by watching how each parent star wobbles, pulled by an unseen planet orbiting it. The wobble shows up as a rhythmic variation in the star's color due to Doppler shifting; the more massive the planet or the closer it orbits the star, the bigger the wobble. In a paper posted on the preprint server astro-ph (0201003v1) on 2 January, physicists Charles Lineweaver and Daniel Grether of the University of New South Wales in Sydney, Australia, identified a subset of 44 exoplanets circling stars that had been monitored long enough to discover all the bodies orbiting at least as close as Mars orbits the sun and as large as or larger than Jupiter.

Extrapolating from trends in mass and orbital distance within this more representative subset, the Australian physicists find that "Jupiters are probably very typical" of the as-yet-unobserved exoplanets, says Lineweaver. They predict that 22 new Jupiter-like exoplanets—as big as Jupiter or larger, orbiting from just beyond the distance of Mars to a bit beyond the distance of Jupiter—will be found orbiting around the 1000 or so stars that have been monitored for more than 3 years. The prospect of familiar-looking planetary systems is more encouraging than earlier extrapolations had suggested, says Lineweaver, because by focusing only on well-studied stars they reduced observational bias and they also included the latest discoveries. (Extrapolation to the abundance of exoplanets as small and distant as Saturn is not yet advisable, the pair says.)

A second group has come up with a similar result by taking a more theoretical approach. In a paper submitted to *Astronomy and Astrophysics*, astronomer David Trilling of the University of Pennsylvania in Philadelphia, cosmochemist Jonathan Lunine of the University of Arizona in Tucson, and astrophysicist Willy Benz of the University of Bern in Switzerland consider how planetary systems created in a computer model compare with the exoplanets observed so far. Their model of planetary system evolution has a swirling disk of gas and dust of the sort from which planets agglomerate. But the disk can also destroy newly formed planets by interacting gravitationally with them and driving them into their star.

Planetary system formation is thus an old-fashioned cliffhanger, with planets heading for the furnace unless someone turns off the conveyor belt in time. Survival in real planetary systems depends on the mass of the planet, the mass of the disk, the lifetime of the disk, and the inherent ability of disk material to drag on the planet. Trilling and his colleagues varied these properties one at a time over plausible ranges in a series of simulations. In each they inserted a single planet into the disk at the distance of Jupiter and noted its fate by the time the disk had dissipated.

To judge by their simulations, "Planet formation is an 'easy come, easy go' business," they write, "with many planets created and many planets destroyed. …" Two-thirds of all model planets migrate too fast and are consumed by their stars before disk dissipation. Ten percent to 30% of the surviving planets come to a stop close to their star. That fits the discoveries so far if about 30% of sunlike stars form planets. But 70% to 90% of surviving giant planets, according to the modeling, should remain too far out to have been found by past searches. Jupiters should be among them. And in such systems, unlike those observed to have giant planets near their stars, there could be room for small, rocky planets like Earth at a comfortable, habitable distance from the star.

Astrophysicist Scott Tremaine of Princeton University sees these results and Lineweaver and Grether's extrapolation as reasonable quantifications of trends hinted at by the discoveries so far, and he looks forward to coming discoveries. As some monitoring records approach the requisite 12 years, Doppler detection of extrasolar Jupiters may not be far off. And searches are in the works for terrestrial-sized planets by looking for planets passing in front of their stars. But Tremaine remains cautious about what these searches will turn up. Speaking as a theorist, he notes that "most every prediction by theorists about planetary formation has been wrong."

–RICHARD A. KERR

More than an artist's conception? There are new signs that planets like Jupiter—possibly with moons and rings—orbit other stars.

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