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THE INCONSTANT CONSTANT

STARS

By Marcia Bartusiak

In 1929 Edwin Hubble made one of the most profound discoveries of twentieth-century astronomy. Using the giant 100-inch telescope atop Mount Wilson, in Southern California, Hubble painstakingly determined that we live in an expanding universe where galaxies rush away from one another at tremendous speeds. The motor that drives this expansion, we now realize, originated in the cataclysmic explosion that gave birth to our universe many aeons ago.

Hubble soon figured out that there is an orderly progression to this cosmic marathon: The more distant the galaxy, he observed, the faster it moves away from us. Appropriately enough, the parameter that describes this rate of expansion is known as the Hubble constant.

It's an ironic label. To the dismay of observers everywhere, this most famous of astronomical constants has turned out to be quite mercurial, going down and up over the last 55 years like a carousel horse. The latest revision in this "constant," in fact, has sparked a heated debate within the astronomical community over the age of the universe. The new estimate could force theorists to modify Einstein's equations of general relativity.

In the Thirties the Hubble constant stood at 526 kilometers per second per megaparsec (a megaparsec is an odd yet handy unit that equals 3.26 million light-years). That meant that two galaxies separated by one megaparsec would be speeding away from each other at 526 kilometers per second because of the universe's expansion.

Working that expansion rate backward in time has also given astronomers a rough handle on the age of the universe. The higher the Hubble rate, in a sense, the less time needed to get back to the Big Bang. With a Hubble constant of 526, the universe turned out to be 1.8 billion years old, an embarrassing result, once geologists realized that the earth was more than 4 billion years old. A great sigh of relief was eventually heard once improved distance and velocity measurements of faraway galaxies brought the Hubble constant down to a sedate 50

kilometers per second per megaparsec. That corresponds to a universe some 20 billion years old—time enough to create all the galaxies, stars, and planets.

But recently a number of astronomers, such as Gérard de Vaucouleurs, of the University of Texas at Austin, and Marc Aaronson, of the University of Arizona's Steward Observatory, have completed new distance measurements that are inching the Hubble constant back up to 100. Some interpret this to mean that our universe is much younger than once thought—a mere ten aeons old.

Could our universe really be such a youngster? "Not at all," declares De Vaucouleurs. He contends that too many other lines of evidence—the well-determined ages of the globular clusters, for instance—confirm that our universe must be 12 billion to 20 billion years old.

What the new Hubble constant does suggest, he goes on to explain, is that Einstein's equations of general relativity, long used to describe our cosmic expansion, may have to be revised slightly. Theoreticians may be forced to reintro-

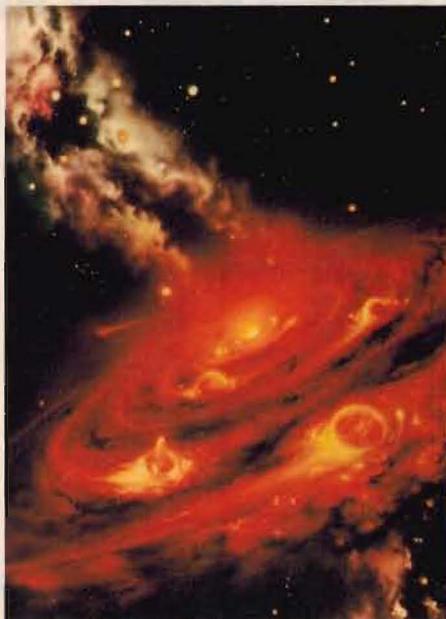
duce Einstein's infamous cosmological constant, which the great scientist himself referred to as the biggest scientific mistake of his life.

Out of desperation Einstein tacked this extra term onto his equations in 1917. His original, unaltered theory posited that the cosmos was dynamic, either contracting or expanding. But then-current observations of the heavens suggested our universe was static and unchanging, prompting Einstein to formulate the cosmological constant to resolve this impasse. The term said there was a repulsive force at work in the universe—a kind of antigravity—that exactly balanced the gravitational attraction of the galaxies, keeping them from moving. But once Hubble revealed that our universe was expanding, Einstein quickly dropped his cosmological constant.

"Physicists often say that Einstein's equations are more aesthetically pleasing without the constant," notes De Vaucouleurs. "But that's not a good reason to dismiss it. We like things to be simple in science, but nature usually turns out to be more complicated."

Inserting Einstein's controversial constant back into his equations would relieve the present dilemma. This is because the repulsive push inherent in the constant dictates that the universe would have expanded more quickly since the Big Bang, thus making the cosmos a bit older than the simple Hubble calculations now suggest. De Vaucouleurs points out that French physicist Jean-Marie Souriau has already derived a small cosmological constant by analyzing the distribution of quasars. Souriau's figure, coupled with De Vaucouleurs's new Hubble constant, makes our universe a pleasing 18 billion years old.

Many astronomers are still convinced, however, that the Hubble constant is closer to 50, making all these extra manipulations unnecessary. But if De Vaucouleurs's higher value is upheld, our cosmological models will assuredly come under closer scrutiny. One result is certain, the Austin astronomer concludes, "Something's got to give." □



Galaxies separating: How fast are they going?