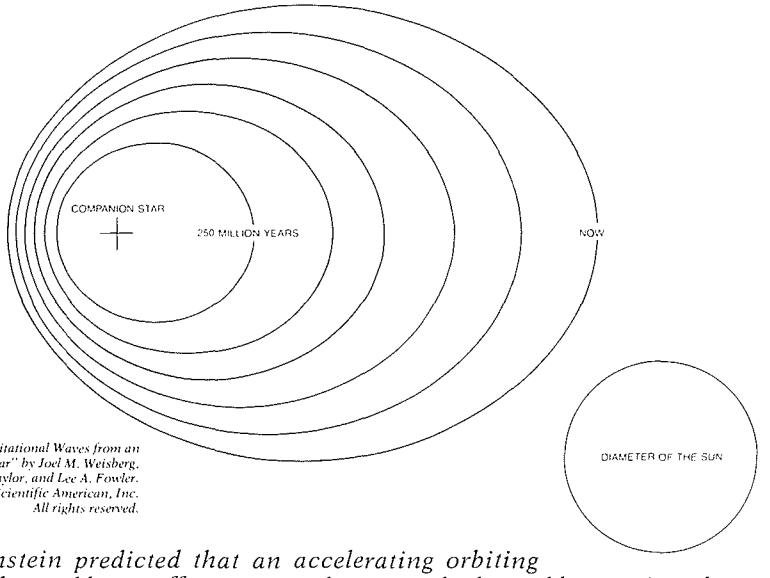
Einstein Was Right

"Gravitational Waves from an Orbiting Pulsar" by Joel M. Weisberg, Joseph H. Taylor, and Lee A. Fowler, in *Scientific American* (Oct. 1981), 415 Madison Ave., New York, N.Y. 10017.

An object 15,000 light-years from Earth has provided "the first strong evidence" for Albert Einstein's theory of gravity, a central component of his general theory of relativity. So report Weisberg and Taylor, physicists at Princeton, and Fowler, a physicist at Atmospheric and Environmental Research, Inc. of Cambridge, Mass.

Einstein (1879–1955) held not only that matter and energy are equivalent and that space and time are integrated; he also stated that gravity could occur as waves emanating at a finite speed from an accelerating mass, rather than as the pulling force that objects instantaneously exert on their neighbors, as Isaac Newton postulated in the 17th century. Yet gravity is too weak an agent for such waves to be directly observed by modern scientific instruments. (Einstein questioned whether the waves would ever be detected.) And most known stars and planets move too slowly to provide meaningful readings. In 1974, however, Taylor and one of his students found a perfect laboratory: a pulsar in the constellation Aquila.

Like the 329 other pulsars found since 1967, PSR 1913+16 is a tiny



Einstein predicted that an accelerating orbiting body would give off gravitational waves, which would cause its orbit to shrink. Above is pulsar PSR 1913+16's orbit every 50 million years from now. The pulsar will coalesce with its companion in 300 million years.

SCIENCE & TECHNOLOGY

(12 to 19 miles in diameter) star made up of neutrons so densely packed that it outweighs the sun. Thought to be remnants of supernova explosions, pulsars emit directional radio beams that sweep the sky as they spin on their axes up to 30 times per second. Unlike most pulsars, however, PSR 1913+16 is a system containing two objects orbiting each other: a pulsar and a silent companion, probably another neutron star. Their orbital speeds (up to 250 miles per second) seem enough to produce powerful gravitational waves. Moreover, PSR 1913+16 is like an enormous clock: The arrival of its pulses at Earth varies precisely with its orbital position. By measuring the intervals, astronomers can discern the orbits and gauge the two bodies' gravitational effects with great accuracy.

Relativity predicts that gravitational waves thrown off as the two stars whirl in space should reduce the total amount of energy in the system. The authors reasoned that this loss would slow PSR 1913+16's orbital speed and gradually shrink both the size of its orbit and the time it takes to circle its companion. Indeed, after six years, the deviation was more than one second—almost precisely the rate predicted by relativity theory. The authors calculate that the pulsar's orbit shrinks 11.5 feet per year. Their experiment constitutes new evidence supporting relativity theory. But they may have gained practical benefits as well—by using Einstein's insights to map objects beyond the range of the strongest telescopes.

Choirs of Hominids

"Did Human Speech Originate in Coordinated Vocal Music?" by Bruce Richman, in *Semiotica* (vol. 32, nos. 3–4, 1980), Walter de Gruyter, Inc., 200 Saw Mill River Rd., Hawthorne, N.Y. 10532.

Linguists agree that present-day human speech serves many purposes, often simultaneously: to express emotion; to demand or deny; to keep the "channel of communication open"; to please the ear. Most linguists attribute to our early ancestors' speech only one function: relaying concrete information, using words as symbols. However, according to researcher Richman, humans had speech before they had words.

Richman bases his conclusion on sounds made by gelada monkeys, found in Western Africa. The geladas are the second most vocal of Old World primates (after man). They keep up a near constant chorus, inhaling and exhaling, varying long and short tones, and changing their pitch. Often two or more monkeys alternate cries in long, complex rhythmic sequences; soon other geladas pick up the pattern and chime in. According to Richman, these geladas are engaged in "contact-calling"—signaling their presence to establish, in effect, a "continuous index of . . . social solidarity." The predictability of a caller's rhythm and sound (his "syntax") is crucial, for that enables all members of the group to participate.

Intricate choral singing by present-day hunter-gatherer societies