with varying effects. "There are many different forms that do appear to be present. Maybe some of the controversy exists because the proteins are slightly different," May suggests.

The latest factor to be found identical to interferon-β_2 is, according to Jack Gauldie of McMaster University in Hamilton, Ontario, and his colleagues, hepatocyte-stimulating factor, which acts on liver cells to increase the synthesis of a group of proteins that are released into the blood during inflammatory responses. This "acute-phase protein response," as it is called, is one of the oldest and most conserved of the body's responses to injury by infection or trauma.

"It is the most important regulator of the acute-phase protein response," comments Vilček. "That puts it right in the middle of responses that occur after infection and injury." Interleukin-1 and tumor necrosis factor, both of which are major contributors to inflammatory reactions, also stimulate some aspects of the acute-phase protein response.

The effects of interferon-β_2 generally resemble those of interleukin-1 and tumor necrosis factor. Interleukin-1 is a fever inducer, for example, and so is interferon-β_2, according to Aarden. Moreover, Aarden has found that interferon-β_2 induces the proliferation of murine thymocytes in an assay that had been considered to be specific for interleukin-1.

The similarities in the activities of interferon-β_2 and interleukin-1 raised concerns for a while about the validity of results with early interleukin-1 preparations that may not have been 100% pure. "The people who had 'interleukin-1' before cloning could have had interleukin-6 instead," explains Charles Dinarello of Tufts University–New England Medical Center in Boston.

Moreover, both interleukin-1 and tumor necrosis factor stimulate interferon-β_2 production, a circumstance that increases the possibility that the interferon might have been contaminating interleukin preparations. Experiments with pure cloned interleukin-1 confirm that its does have the effects originally found for it, however. "Recombinant interleukin-1 worked in most of the assays in which it was supposed to work," Dinarello says.

The overlap of the activities of interferon-β_2, interleukin-1, and tumor necrosis factor illustrates a prominent feature of the cytokines. Cytokines often display a high degree of redundancy in their effects. The body apparently takes no chances when it comes to fighting off foreign invaders and injury. "All these activities [of interferon-β_2] should not confuse us," Revel declares. "They all play a role in the defense of the organism against infections." ■ JEAN L. MARX

Gamma Rays for Christmas

The long-awaited observation of gamma rays from Supernova 1987A has given astronomers their first direct observational evidence for the theory of explosive nucleosynthesis—the idea that iron and most of the other heavy elements in the universe were created by supernovas at the instant of detonation.

The observations, which were reported on 14 December at a nuclear spectroscopy symposium in Washington, D.C.,* were made independently by two instruments. The first was the gamma-ray spectrometer aboard the National Aeronautics and Space Administration's (NASA's) Solar Maximum Mission satellite. The data reported at the symposium ran from August, when the gamma rays were first detected, until October. More recent data is still under analysis, according to principal investigator Edward L. Chupp of the University of New Hampshire.

The second set of observations were obtained by two balloon-borne experiments flown in October and November from Alice Springs, Australia, as part of NASA's Fall Supernova Observation Campaign.

Visible in both sets of data are gamma-ray emissions at energies of 847 kiloelectron volts (KeV) and 1238 KeV—precisely the experimental signature astronomers have been waiting for. These two energies correspond to the most prominent gamma rays emitted by the decay of radioactive cobalt-56. Their observation thus confirms a key link in the supernova's chain of element creation.

According to the standard theory of supernovas, the detonation of 1987A produced copious amounts of the radioactive isotope nickel-56. Cobalt-56 was formed soon thereafter as a decay product of the nickel. Now, several hundred days later, the cobalt is slowing decaying in its turn and transforming itself into iron-56, which is stable. Indeed, this latter isotope is the most common form of iron. Astronomers are confident that virtually all of the iron in the universe—including all of the iron found on Earth—ultimately came from supernovas just like this one.

Although this theory has now been confirmed in its essentials, however, the details of the new gamma ray observations present the astronomers with a number of mysteries.

Most striking is the fact that the Solar Maximum instrument began seeing gamma rays last August, at about the same time that x-rays were first detected from the supernova by instruments aboard the Soviet Union's Mir space station and Japan's Ginga satellite. This is odd because most astronomers had assumed the x-rays were actually gamma rays that had lost energy as they tried to pass through the supernova's expanding shell of debris. Since gamma rays come from the cobalt, and since the cobalt is thought to be located in the deep interior of this shell, most astronomers had assumed that the gamma rays would not appear until several months after the x-rays. Before that could happen, they said, the shell would have to expand still more and become thin enough to let the gamma rays come out directly.

Apparently, the astronomers' assumptions were wrong. On the other hand, the x-rays themselves were detected about 100 days earlier than predicted. According to some researchers, both anomalies could be explained if there were turbulence in the supernova shell. If so, then swirling eddies of gas might cause some of the cobalt to well up from the deep interior, and thus become visible on the surface. ■

M. MITCHELL WALDROP

* "X-Ray Spectroscopy of Astrophysical Sources," Washington, D.C., 14 to 16 December 1987.

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