In a remarkable case of parallel research, no less than five different research groups involving 11 laboratories produced genetically-engineered molecules of free-floating CD4 at about the same time. Each used slightly different procedures—for example, different mammalian or insect cells to grow CD4 molecules in—and hence produced a slightly different version of the truncated receptor. But all found the same result—the virus was blocked and cell-to-cell infection was reduced or eliminated. Such independent confirmation makes it likely that the result is not a fluke and will undoubtedly help persuade federal regulators to allow early human trials.

But the studies so far suggest that the technique works best when the decoy receptors far outnumber the virus—perhaps by thousands to one. That raises a number of concerns: Will flooding the human body with the potent CD4 molecule interfere with the normal operation of the immune system—for example, preventing T-cells from doing their job? Experiments by Ellis Reinherz and his colleagues at Harvard Medical School suggest that will not be a problem. In a test tube, at least, T-cells continue to kill foreign cells and to respond to immune-system molecules in the presence of free-floating CD4 receptors.

Will the presence of a large protein like CD4 in the blood stream cause toxicity problems? "You don't really know what will happen medically until you use it in people," cautions Robert Schooley of Massachusetts General Hospital. And before that happens, he says, the CD4 molecule will face additional trials: "First it will have to go into a number of increasingly human-like animals. Quite a few immunological assays or tests will also need to be used. But once that is done, I think it will be ready to go into people—this year, I would hope."

What might CD4 mean for people with AIDS? The scientists involved are still quite cautious in what they say to the press, because no one wants to raise false hopes. But clinical trials are already being planned and there is no denying that the cloned CD4 molecule—or perhaps a smaller molecule related to it—is a potentially major advance. Researchers speculate that CD4, by reducing the number of viruses attacking the immune system and slowing their replication, might also slow the progress of the disease. And given in combination with other drugs such as AZT, CD4 might allow the use of smaller doses of AZT, reducing that drug's harmful side effects.

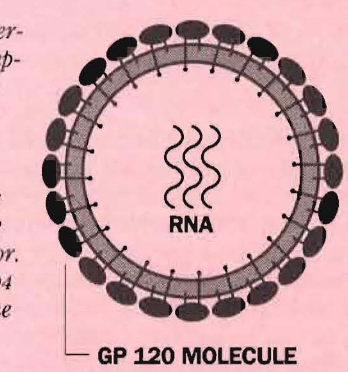
Several companies—including Genentech, Smith Klein French, and Biogen—are already gearing up to produce large enough quantities of the new molecule for clinical trials. The technique is essentially a large scale version of the method used in the laboratory—growing CD4 in animal cells. According to Biogen's Richard Fischer, "We have a system which is a sophisticated fermentation reactor—essentially a lot of stainless steel pipes—for growing large quantities of animal cells. We can make vats of the stuff." It will not, however, be cheap. Genentech's new heart attack drug, TPA (see *Science Impact*, September, 1987), which is made by a similar process, sells for $2,000 a dose.

Scientists are also experimenting with smaller versions of the CD4 molecule that could be produced more easily and cheaply—in bacteria, for example.

But the real question is whether or to what extent the molecule will help people with AIDS. Look more more news of "soluble" CD4 later this year.

Know the Enemy: The AIDS Virus

Like other viruses, the AIDS virus consists of genetic material—in this case, RNA—wrapped up in a coat of protein and fatty membrane. Protruding through the coat is another protein, known as GP120, which is the part of the virus that attaches to other cells by latching onto the CD4 receptor. "Soluble" or free-floating CD4 molecules might thus keep the virus from attaching to and infecting cells.



Astrophysics

The Supernova—One Year Later

Early last year astronomers witnessed the explosion of a relatively nearby star—an event that last took place in 1604, before the invention of the telescope. Since then supernova 1987A has become a central focus of astronomical research: It is a golden opportunity, centuries overdue, to confirm or challenge current theories on a massive star's demise. The supernova is located just 160,000 light-years from Earth in the Large Magellanic Cloud, a small companion galaxy of the Milky Way. And although this explosion was far dimmer than expected, it has still earned a special niche in the annals of astronomy for several reasons:

Neutrino signals. Nearly a day before the blast became visible, bursts of ghostly particles called neutrinos were recorded by underground detectors in Ohio and Japan. This historic signal—the first of its kind—indicates to astronomers that they likely witnessed the very moment of the star's detonation and the simultaneous birth of a neutron star. This odd, ultradense form of matter—more massive than the sun yet only about a dozen miles in diameter—is thought to form when a star at least eight times as large as our sun explodes. The neutrino signal also ushered in the new science of neutrino astronomy, boosting plans for the construction of even larger neutrino "telescopes."

A Novel Explosion. Although astronomers expected the exploding star to be a huge one of the type known as a red supergiant, photographs from before the blast suggest that it was a smaller, hotter star, the blue supergiant Sanduleak –69°202. This finding confirmed the suspicions of some theorists that more than one type of star can violently explode. It also explains why the supernova was dimmer than expected: With a more compact star, the fireworks were less spectacular. Other faint supernova explosions in the past were probably overlooked because they are difficult to see, especially in distant galaxies.

Creating New Atoms. By the end of 1987, high-energy radiations coming from the supernova remnant provided the first direct evidence that exploding stars do indeed synthesize new atoms of the higher elements. This appears to confirm the idea that iron and other elements essential to life—including those in our bodies—were formed in such explosions: That, as physicist William Fowler put it, "Each one of us and all of us are truly and literally a little bit of star dust."

The Egg Is Hatching

Although the supernova reached its peak in brightness last May and is now no longer visible to the unaided eye, scientific study of the exploding star is intensifying. "The egg is just now hatching," says stellar-evolution expert Stan Woosley of the University of California at Santa Cruz.

As the shell of debris from the supernova races outward at tens of millions of miles per hour, the remnant is becoming more and more transparent. Consequently, astronomers are able to probe deeper and deeper into its inner layers. By the fall, gamma-ray detectors on a satellite and on specially launched balloons were picking up signals from radioactive cobalt—a clear sign that new atoms had been born.

A Forge for Atoms

According to the long-held theory of explosive "nucleosynthesis," much of the iron in the universe, as well as the elements heavier than iron, are forged in these searing blasts. What scientists think happens is this:

Massive stars generate their energy by continually fusing light elements into heavier ones: First, hydrogen into helium; then, helium into carbon and oxygen, which serve as the raw materials for even heavier elements, such as magnesium, silicon, sulfur, and calcium. The cycle ends with iron: Heavier elements are not ordinarily formed by a gradual fusion process. So the core of the star, having run out of fuel, collapses to form a neutron star, releasing a flood of neutrino particles. The rebound from that collapse sends an extraordinarily powerful shock wave through the star, explosively fusing heavier elements from cobalt to uranium. When the shock wave reaches the stellar surface, the star is literally blown apart, launching all these elements—the stuff of future stars and planets—into space.

The evidence for this course of events has been circumstantial, based on observations of centuries-old supernova remnants and painstaking laboratory measurements—until last year.

A gamma-ray detector aboard the Solar Maximum Mission satellite, in Earth orbit since 1980 to study the sun, began to see gamma rays emanating from the supernova in August. Steven Matz and Gerald Share of the Naval Research Laboratory in Washington, D.C., determined that the gamma-ray energies were precisely those expected when radioactive cobalt slowly decays into iron. Presumably, huge amounts of nickel forged in the blast—enough to construct 20,000 Earths—had earlier decayed into the cobalt.

Share notes that his group, which includes scientists from the University of New Hampshire and West Germany's Max Planck Institute, was cautious at first. "It was always possible that nature was fooling us," he says. But the signal was confirmed when two other research teams mounted gamma-ray detectors aboard balloons and lofted the instruments to 120,000-foot altitudes from central Australia in October and November. To be successful, the detectors had to rise above much of the atmosphere, which absorbs gamma rays.

"These detections were the culmination of twenty to thirty years of effort," says Share, "directly proving that supernovae are the breeding ground for elements from iron to uranium and that such cataclysmic stellar deaths planted the seeds for the birth of life on Earth." The iron in our blood and the calcium in our bones are atoms that were fused in massive stars that exploded billions of years ago.

Why a Supernova Glows

The observations of gamma radiation from cobalt also explain why a supernova explosion glows so long. The radioactivity that cobalt gives off as it decays into iron apparently heats the debris from the explosion, and that is the glow that lingers. In fact, the fading of the supernova since last summer exactly matches the 78-day "half-life" or decay period of cobalt.

A further indication that the supernova blast had formed a neutron star would be pulsar signals. If the neutron star is pointed in a favorable direction, astronomers will be able to detect periodic signals as it whirls around on its axis dozens of times each second, causing beams of radiation to regularly sweep across the Earth like a lighthouse beacon. The first pulsar signals would be X-rays or gamma rays, because it may be decades before radio pulses can get through the supernova debris. Gamma-ray astronomer Gerald Fishman of the NASA Marshall Space Flight Center in Alabama says that he and his colleagues at the Lockheed Research Laboratory in California are checking for pulses in the data gathered during their October balloon flight.

SCIENCE WATCH

(continued from page 1)

Sciences, the new knowledge gained by the effort would benefit biology and medicine in many ways, aiding the diagnosis and treatment of many of the 3,000 known inherited diseases. The project would determine the identity, biological purpose, and eventually the composition of the roughly 100,000 genes found in a human cell.

Plastics That Conduct Electricity. A West German company recently announced a plastic that conducts twice as well as an equivalent weight of copper. A Japanese-American joint venture recently began marketing in Japan a tiny rechargeable battery with a plastic electrode that holds three times as much electricity as existing batteries.

These applications may be only the beginning, says Alan G. MacDiarmid of the University of Pennsylvania, in whose laboratory conducting plastics were first discovered. New fabrication methods that lead to purer materials and new ways of "doping"—adding small amounts of chemicals to the plastic to make it conduct—may eventually lead to plastics that are better and more versatile conductors than any metal.

Fake Fat. Nutrasweet, a division of the Monsanto Company, plans to market a new low calorie, low cholesterol fat substitute made from egg whites and milk. The new product, which has 1.3 calories per gram, compared to 9 calories per gram for fat, cannot be used for frying or baking. Instead it is likely to be used to in products such as "diet" ice creams and salad dressings.

Because the fat substitute uses natural ingredients, unlike fake fats being developed by other companies, Nutrasweet claims it does not need government approval; the Food and Drug Administration, however, is looking into the claim.

Early Stroking Helps Old Age. In rats, anyhow, and presumably in humans, stroking and handling early in life help prevent memory lapses and other mental losses in aging. So say scientists at McGill University in Toronto and Stanford University in California. They found that the early handling led to a permanent increase in sensitivity of the part of the brain that controls the response to stress—and consequently lower levels of stress hormones that can damage brain cells.