the control of its own regulatory sequences, in the appropriate tissue but not in an inappropriate one. Moreover, expression is high; about 3000 copies of the mRNA of the transferred gene are made per cell. And the antibody protein itself is found in the blood of the animals.

The key to tissue-specific expression in this case, Storb and Brinster speculate, may be an enhancer sequence located in the large noncoding intron of the antibody gene. Enhancers, which boost gene transcription, have been found in other antibody genes and appear to work only in B cells.

In previous work, the Brinster group, in collaboration with that of Richard Palmiter of the Howard Hughes Medical Institute of the University of Washington found that high expression of a transferred viral gene or of a gene coding for rat growth hormone could be obtained if they were linked to a sequence from the metallothionein gene that very actively promotes gene expression (*Science*, 24 December 1982, p. 1298).

More recently, the Brinster and Palmiter groups have shown that the gene for human growth hormone, which they also linked to the metallothionein promoter, is expressed in mice where it causes growth stimulation, just as the rat hormone did. In both cases, large quantities of the hormones were made in the liver, a pattern of expression that resembles that expected for the metallothionein gene from which the promoter was derived. Growth hormone is normally made in the pituitary gland.

Another gene, that for chicken transferrin, an iron-carrying protein found in blood, also is expressed under the control of its own promoter when transferred into mice, according to Brinster and G. Stanley McKnight, who is at the University of Washington. "Most of the animals expressed the gene," Brinster says, "even though it has a chicken promoter."

Expression of the transferred gene was five to ten times higher in the liver, the normal site of transferrin production, than it was in several other tissues. However, here the case for tissue specificity is not as good as that for the antibody chain gene. The apparent preference for expression in the liver may have simply reflected the high degree of protein synthesis generally occurring in this tissue.

Despite the apparent specificity of expression of the transferred antibody gene, Brinster says, "We don't have anything like what the *Drosophila* people have." He was referring to recent successes in introducing new genes into fruit flies. Three groups of investigators have now found that expression of the transferred genes follows normal developmental patterns in the recipient flies. The genes were active only in appropriate tissues, for example, even though they integrated into the *Drosophila* genome at positions other than the normal ones.

To introduce the genes into fruit flies, the investigators used a method developed by Allan Spradling of the Carnegie Institution of Washington (in Baltimore) and Gerald Rubin, who is now at the University of California at Berkeley; in this method the gene is inserted into a transposable element before injection into the eggs. The transposable element serves as a vehicle for inserting single copies of an intact gene with its flanking sequences into the *Drosophila* genome although there may be several such insertions per cell.

In contrast, when the genes that are injected into mouse eggs become integrated into the genome, several copies are usually linked in a tandem array. Control of genes inserted as single copies may be more normal than when several genes are linked in tandem. Nevertheless, Storb and Brinster note that they see tissue-specific expression of the antibody chain gene in mice even though the numbers and positions of the integrated gene copies vary from animal to animal, a finding that resembles those in *Drosophila*.

Investigators studying *Drosophila* are already in position to begin studying the factors that regulate the normal expression of genes during the development of a living animal. If the observation of tissue-specific expression of the antibody chain gene is verified by further work, similar experiments may soon be possible in a mammal.—**JEAN L. MARX**

Additional Reading

1. R. L. Brinster, K. A. Ritchie, R. E. Hammer, R. L. O'Brien, B. Arp, U. Storb, *Nature (London)*, **306**, 332 (1983).
2. R. D. Palmiter, G. Norstedt, R. E. Gelinas, R. E. Hammer, R. L. Brinster, *Science* **222**, 809 (1983).
3. G. S. McKnight, E. A. Kuenzel, R. E. Hammer, R. L. Brinster, *Cell* **34**, 335 (1983).
4. S. B. Scholnick, B. A. Morgan, J. Hirsh, *ibid.*, p. 37.
5. A. C. Spradling and G. M. Rubin, *ibid.*, p. 47.
6. D. A. Goldberg, J. W. Posakony, T. Maniatis, *ibid.*, p. 59.

A Landmark in Fusion

Fusion physicists have hailed it as a milestone, 30 years in coming: on 3 November, scientists at the Massachusetts Institute of Technology's (MIT's) donut-shaped tokamak reactor, the Alcator C, finally achieved the minimum plasma density and confinement time needed for fusion energy breakeven.

While the Alcator C plasma was nowhere near hot enough for sustained fusion, the event had an undeniable symbolic importance. Moreover, the way that the MIT researchers did it has considerable technical importance as well.

Energy breakeven in a deuterium-tritium plasma, which is the easiest fusion fuel to ignite, requires two things. First, the temperature of the plasma must exceed some 200 million degrees Celsius; that milestone was achieved by the Princeton Large Torus in 1978. Second, the product of plasma density and plasma confinement time must exceed the "Lawson" criterion, 6×10^{13} nuclei per cubic centimeter-second; the Alcator C, which is designed for very high densities, came within a factor of 2 of this number in 1981. But then things stalled. When the MIT team tried to increase the density further by raising the fuel supply gas pressure, the confinement time topped out and refused to budge.

This year, however, Alcator team leader Robert Parker and colleagues Martin Greenwald, Dave Gwinn, and Steve Wolfe tried another method, using a kind of high-tech BB gun to inject the plasma with frozen pellets of deuterium. It worked. The evaporating deuterium provided a sudden, massive pulse of fuel that boosted densities to more than 10^{15} nuclei per cubic centimeter with a confinement time of 50 milliseconds—giving a Lawson product of 6×10^{13} to 8×10^{13}.

Pellet injection is not a new idea—the technology used at MIT was developed at Oak Ridge National Laboratory—but it has never before had such a stringent test. "Now I expect that it will be a standard feature on all the advanced machines," says Parker. In particular, it could prove very suitable for the Tokamak Fusion Test Reactor in Princeton, which is expected to achieve *all* the criteria for energy breakeven by 1986 or 1987.

—**M. MITCHELL WALDROP**