Bacteria make brain opiate

With genetic engineering techniques, bacteria have been made to produce the mammalian pain-countering chemical beta-endorphin. This compound, naturally produced by the pituitary gland, has been found effective as a painkiller and is currently being tested as a treatment for both depression and schizophrenia (SN: 11/25/78, p. 375). The beta-endorphin now used in clinical tests is produced by laborious chemical synthesis, for approximately $100 per milligram. Bacterial production of the material should reduce its cost substantially and allow more extensive research on its effects.

At the meeting in Washington of the Association of American Physicians, John D. Baxter reported that a gene from mice had been modified and transferred into bacteria. The bacteria produced approximately 80,000 copies per cell, 1 to 2 percent of the bacterial protein synthesis. The scientists used an enzyme to snip beta-endorphin from the product, which included part of a bacterial protein. The resultant beta-endorphin binds to opiate receptors and exhibits an opiate-like action on cells growing in laboratory culture, Baxter says.

Because mouse beta-endorphin differs from the human material in only two of its 31 amino acids, Baxter says it should not be difficult to modify the mouse gene to allow bacteria to produce the human form for possible therapeutic use.

A stretch of mouse DNA for the precursor of beta-endorphin was the starting material in Baxter's work. He and colleagues cleaved the molecule and added one codon to the incomplete message and a stop signal to the end. The gene was connected to a portion of a bacterial gene, beta-galactosidase, in a plasmid as has been done in several other gene-splicing procedures. The work does, however, illustrate several new approaches in synthesis of mammalian proteins by bacteria. Baxter points out, for instance, that there was minimal use of chemically synthesized DNA. In many cases he expects it to be easier to use natural genes than to synthesize genes chemically.

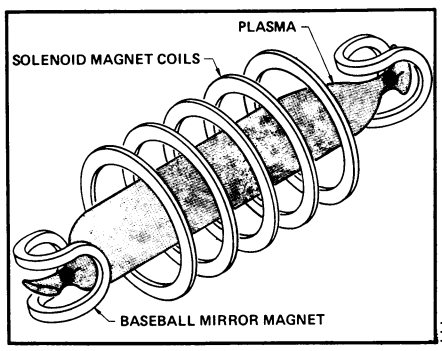
Working with Baxter of the University of California at San Francisco were James L. Roberts, now at Columbia University, John Shine, now at the Australian National University, Ivy Fettes and Nancy Lan. □

TMX: Electric plugs for a magnetic mirror

Confinement is one of the basic necessities for controlled thermonuclear fusion research. A plasma of ions and electrons, in which the fusions are to take place, must be held in some kind of vacuum chamber. Many ideas have been tried; several have shown promise, but the final answer has not yet manifested itself. One of the latest schemes, the so-called TMX or tandem mirror experiment at the Lawrence Livermore Laboratory in California, shows promising results, experimenters working with it report.

The TMX uses two plasmas as end plugs to confine a third between them. It is an outgrowth of research on "magnetic mirrors" that has been going on for more than thirty years, and it is an attempt to repair their greatest deficiency, the tendency for the mirrors to be very transparent.

For fusion purposes a plasma must be hot. Therefore the means of containment must hold it in without letting it touch the walls of the chamber surrounding it. For years it seemed, and to many it still seems, that levitation and containment by a magnetic field was the best method. If the experimental chamber was a cylinder, designers tried to arrange magnetic mirrors at the ends, a field configuration that would contain the plasma by bouncing the ions and electrons back. The best kind of magnetic mirror would have field lines that joined across the ends of the tube. With the electromagnet coils it is possible to make, that geometry is impossible. The best that can be done is to strengthen the field at the ends. This reflects some, but a lot still gets out.



TMX: *A new twist helps confine plasma.*

TMX was designed to lower these end losses. It put a so-called baseball mirror at each end of the solenoidal tube. The baseball mirror gets its name from the shape of its coils, which are like the seams on a ball. It holds a dense plasma with a twisted shape. The combination generates an electric field that serves as a good barrier to migration of particles between the end plasmas and the solenoid plasma. To keep up the barriers the density of the baseball plasmas must be maintained. This means continually feeding them material to replace their losses to the outside world, but by accepting this cost, experimenters can maintain the solenoid plasma in a state nearer to the hopes of fusion technologists. The first TMX experiments give a confinement nine times that possible without the plugs. □

Binary pulsar #3: Astrophysical bonus

Pulsars are rarely found in binary star systems. As Joseph Taylor of the University of Massachusetts points out, of the 300 known pulsars only three, maybe four, are members of binary systems. The identification of the third binary pulsar, which was reported at the meeting of the American Physical Society in Washington at the end of April, is not only a one-in-a-hundred finding for dynamical astronomy. David Helfand of Columbia University reported that it appears also to be the first instance of a neutron star that had been observed by the X radiation rising from its surface and the first time astronomers think they have a photographic image of a pulsar's companion.

That pulsars should so rarely appear in binary systems is a striking difference between them and ordinary stars. The majority of ordinary stars are found in binary or multiple star systems. One suggested explanation for the difference is that pulsars are formed during supernova explosions, and the explosion of one star blows the companion away. If that be true, nevertheless a few companions have survived. Astrophysicists are eager to study them for the light they can throw on the history and physics of pulsars.

Taylor stresses that the rarity of binary pulsars is not a matter of not having looked but of having looked and not seen. A pulsar exhibits its membership in a binary by a cyclic variation in the timing of its pulses. It can be tedious and time consuming to confirm such a variation, but enough pulsars have been observed for long enough to have raised suspicions of binary status in many cases if binary systems were in fact numerous. The observations that showed that this one, PSR 0655+64, is a binary were made by two graduate students, Peter R. Backus and Marc Damashek.

It is a close, quick-moving binary system. The orbital period is 24 hours and 41 minutes and the diameter of the orbit about a million and a half kilometers. The orbit is almost a perfect circle. The eccentricity is less than one part in a thousand, Taylor says. One question for future research is: "Why so circular?" These parameters, which are computed from the pulse timing variations, place some constraints on the nature of the pulsar's companion. Obviously the companion cannot be a giant star that would occupy more space than the orbit nor a violently variable star that would disrupt it. A small star and a quiet one, a white dwarf or a slow variable is Taylor's suggestion.

While Taylor, Backus and Damashek were finding a binary pulsar with the 300-foot radiotelescope at Green Bank, W. Va., Helfand and Robert Novick, also of Columbia University, were looking for neu-

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