recognizing the terminal sugar of the enzyme's carbohydrate group—this can be thought of as the "address label." The carbohydrate on the placental enzyme terminates with sialic acid, but when terminal sugars are cleaved off biochemically until mannose is exposed, Brady says, the uptake by the correct cells is vastly improved. In work on animals published a few years ago, he reported 20 percent uptake, but claims "in the past two years we have done very much better." Because different cells recognize other terminal sugars, doctors could eventually take advantage of this mechanism to target enzymes to specific cells in the treatment of other diseases.

Unfortunately, β-glucosidase is expensive and only available in small quantities. Robert J. Desnick, chief of the division of medical genetics at the Mount Sinai School of Medicine (New York, NY), says manufacturing enzyme using biotechnology—either tissue culture or recombinant DNA—could allow technicians to produce greater quantities at lower costs. Since bacterially produced enzyme would probably not be glycosylated, systems such as yeast could be used that would glycosylate the newly synthesized protein. Alternatively, researchers could ensure uptake by the desired cells by attaching the proper sugar groups to a bare enzyme.

Scientists have also tried liposomes and red blood cells to encapsulate and target enzyme in the treatment of Gaucher disease, but results have been mixed. "The advantage of using red cells is that a lot of the accumulated glycolipid is derived from catabolized red cell membranes," points out Garret M. Ihler of the Texas A&M College of Medicine (College Station, TX). This means that red cells packed with enzyme would tend to accumulate where enzyme is needed most. Ihler notes that the cells can be designed to release all the enzyme at once, or to circulate in the bloodstream for weeks, yielding continuous low-level infusions. "The red cell approach potentially has some advantages, but those may or may not be significant," he concludes.

"My own feeling that enzyme replacement may not work" for Gaucher disease, says Ernest Beutler, chairman of the department of basic and clinical research at the Scripps Clinic (La Jolla, CA). "Our experience has been sufficiently disappointing that we think a much more fruitful line would be cloning the gene and using gene replacement," he says.

Still, there are other ways to engineer more effective enzymes. Enzon (Piscataway, NJ), works on making non-allergenic and longer circulating enzymes by covalently binding strands of polyethylene glycol (PEG) to non-essential components of the enzyme. According to Frank F. Davis, a consultant for the company and a professor at Rutgers University (New Brunswick, NJ), Enzon is working on an asparaginase to treat cancer, and on enzymes to treat Fabry disease and gout. "Part of our current strategy," he says, "is not only to render the enzyme non-immunogenic, but to target it" by attaching sugar groups to the PEG or incorporating the enzyme into liposomes.

While there is a long way to go before scientists can target effective, long-lasting enzymes to reach specific cells, researchers expect that information learned about one enzyme system eventually will be applicable to many. **—Arthur Klausner**

GRANTS & INCENTIVES

AUSTRALIA UPS BIOTECH SUPPORT

CANBERRA, Australia—The Australian government has increased its financial support for biotechnology significantly in the past few weeks. The package includes a substantial budget for R&D as well as incentives to encourage private investment in biotech.

The government has recommended a 1983–84 budget of $A71 million for the Australian Industrial Research and Development Incentives Scheme, which received $54 million in 1982–83. Included in the $71 million is $16 million for grants to aid companies in establishing an R&D capability, $2.5 million for specific approved projects administered by the new National Biotechnology Program, and $10 million for projects considered to be in the national or public interest, such as development of a malaria vaccine.

In addition, the budget allocates $1.5 million to the research grants component of the National Biotechnology Program, designed to underwrite projects in basic research institutions that may be commercially exploitable. In conjunction with the program, the government has established a National Research Fellowship Scheme designed to bridge the personnel gap between industry and academia.

The budget also provides $7.8 million for development of biotech programs within the Commonwealth Scientific and Industrial Research Organization, and $400,000 for biotechnology research at the Howard Florey Institute of Experimental Physiology and Medicine.

The government has also finally announced its long-awaited and much speculated-upon venture capital incentives and increases in loan capital. Based upon recommendations by the Finance Committee of the Australian Academy of Technological Science, the government initiative makes it possible for investors to claim 100 percent tax deductions for investments in high technology, including biotechnology. A Management and Investment Company Licensing Board will be established to license specific companies deemed eligible for the deduction. Because the number of licenses to be issued is limited, there is already intense competition for them.

According to the Minister for Industry and Commerce, Senator John Button, the government also intends to widen the powers of the Australian Industry Development Corporation (AIDC) to enable it to invest directly in industry in addition to its traditional function of providing loans to investing companies. The new guidelines specify that AIDC must give priority to financing manufacturing industries, particularly those that incorporate new or improved technologies. A proportion of its profits, to be determined by the Minister, will go to the government, which in return will charge no interest on the capital it provides. AIDC's authorized capital is $150 million, an increase of $50 million over last year. The agency is expected to play a significant role in commercial development of government-sponsored research.

—Vimala Sarma

UNIDO CENTER: FUTURE CLOUDY

Although 25 countries signed statutes creating the International Center for Genetic Engineering and Biotechnology at a meeting in Madrid in September, they failed to settle its financing or to select a site. A report on the behind-the-scenes struggle to organize the center, which was initiated by the United Nations Industrial Development Organization to bring modern biotechnology to developing countries, will appear in the January issue of BIO/TECHNOLOGY.