

According to recent statistics⁵ annual sales worldwide for biotechnology-related drugs, excluding antibiotics but including vaccines and diagnostics, grew to \$4 billion in 1991. For agricultural-related biotechnology products, worldwide sales exceeded \$200 million.

The following is a review of current biotechnological activity, and commercial implications.

A. MEDICAL RESEARCH and HEALTH CARE

Biotechnology is recognized as a driving force in medical technology. In the period from 1991 to January 1992, public offerings for biopharmaceutical ventures in the USA had reached \$4.5 billion; more than the industry raised in the ten year period 1980-1990⁶.

In 1987 more than 100 new products were under development, but only few reached the market. Currently, biotechnology-related drugs, vaccines, and diagnostics are yielding more than \$4 billion annual sales world wide. A number of significant products have emerged. Many more are being evaluated currently, involving diagnostic and drug-delivery methods, genetic and protein engineering and gene-based immunology.

A recent illustration of the advances in medical biotechnology is provided by Tracy, the super-sheep. Tracy is behind a multimillion dollar deal between Bayer, the German chemical giant and Pharmaceutical Proteins, a venture capital start-up organization based in Edinburgh⁷. This contract could mark the first step in the commercial use of genetically engineered animals as "biological factories". Genetically modified, Tracy synthesizes the protein AAT (alpha-1-antitrypsin) at a cost of \$100 per gram. The substance, extracted from the milk of a super-sheep like Tracy, will not only ease the shortage of ATT but eventually will replace the traditional method of producing ATT in human blood. Human deficiencies of this protein cause liver failure or emphysema. The development of this alternative source of ATT will significantly ease the cost burden of current treatment, which can reach \$20,000 per year. What began in the mid-1970s as a dream has become one of the commercial milestones of biotechnology in early 1992.

Concurrently, a team of Canadian scientists from the Hospital for Sick Children in Toronto announced on February 28th., 1992, the successful transplant into mice of stem cells. These are human bone-marrow cells involved in the production of blood. In allowing human conditions to be more extensively replicated in animals, breakthroughs of this significance may well facilitate the development of new gene-altering treatments for hereditary diseases, leukemia, AIDS, etc. As well, this experiment should have major implications in speeding up the development of new therapies in