foundation for the applied areas that make up the downstream side of biotechnology. They have been successful.

In the first chapter, J. Messing focuses on the biochemical methods that form the basis for analyzing the primary structure of genetic information. The enormous amount of information necessitates manipulation by computer, as discussed by J. L. Modellevsky. P. W. Gray and D. V. Goeddel present a masterly account of the isolation of human γ interferon and determination of the DNA structure of its corresponding gene. The sequences important for the initiation of RNA synthesis are different than those for other interferons.

W. Krivit explores the potential for bone marrow transplants to correct inborn errors of metabolism. This is of course highly speculative, without a solid set of case analyses as yet. In M. J. Cline's presentation of research on gene therapy there is a clear awareness of the possible problems consequent upon introducing a new piece of DNA into a host genome—for example, a foreign promoter could switch on a normally silent host oncogene.

There is also a section devoted to monoclonal antibodies and lymphoid cells in biomedical technology. For example, the oral administration of the appropriate monoclonal antibody protects neonatal pigs and calves against toxic diarrhea (P. L. Sadowski, et al.). M. Mudgett-Hunter et al. show how monoclonal antibodies to a simple hapten can serve as a model system to study the intricate specificity of an antigen-antibody combining site. This work has given rise to a clinical assay for the determination of digoxin in patients' sera.

One problem with monoclonal antibody technology is non-specific tissue localization. J. Martinis et al. illustrate how tumor immunotherapy can be improved by using hybrid antibodies that contain two different antigen binding sites—one specific for the tumor, the other for the toxin, drug, or radioactive agent. The authors also provide a succinct review of immunoaffinity chromatography. In addition to these papers, some discussion of DNA probe technology (BIO/TECHNOLOGY, 1983, 1:471) as an adjunct or alternative to monoclonal antibodies would have been appropriate.

The use of biotechnology in agriculture is not overlooked. U. Courage-Tebbe et al. discuss their biochemical studies on the sucrose synthase gene in *Zea mays*. They have investigated the DNA structure of the transposable element *Ds*. Such controlling elements, inserted at specific sites in the DNA, could create additional genetic variability.

J. Schroder et al. present some of their studies on Ti plasmids, showing that the morphogenetic potential of plant cells need not be affected on introducing foreign genes via Ti plasmids. Some speculation on why dicots and gymnosperms, but not the technologically important monocots, are infected would have been of interest. C. E. Gree, in discussing plant tissue culture, shows that a dominant mutation controls the overproduction of threonine in tissue culture and in the seeds of regenerated plants. This has a clear application, but further basic work is needed to isolate lysine, tryptophan, and methionine overproducer mutants.

Another section deals with the design of new drugs for combating disease. C. J. Shih et al. discuss the introduction of chiral centers into therapeutic agents. Their strategy is to assemble a series of prefabricated, optically active building blocks, successively synthesizing the required molecule. C. A. Claridge examines the use of mutational biosynthesis, in which a special nutrient is added to a mutant organism for new secondary metabolite production. A new group of aminocyclitol antibiotics has been developed in this way, but only with moderate commercial success. He also addresses the problem of directed biosynthesis for new antibiotics, but areas such as new agents against fungal and protozoal infections and anti-tumor drugs are unfortunately not reviewed.

Janet Westpheling gives an excellent overview of basic work on *Streptomyces* aimed toward improving fermentation efficiency. R. H. Abeles discusses suicide enzyme inactivators, which have the advantage that the inactivating species is not released into solution. This enables closer control of their possible activity as pharmacological agents.

C. L. Cooney presents a very apt introduction to chemical and fuel production by fermentation. By the year 2000, he expects that biotechnological proceses will provide a market of $10 billion per year for the chemical industry. The use of basic research toward improving fermentation processes has been given considerable thrust by H. D. Peck and his team in their work on inorganic pyrophosphate as an energy source. J. C. Linden and A. Moreira provide useful analyses of the problem of inhibition by fermentation products. This is one of the major limitations in the development of fermentation processes for chemicals production.

G. C. Walker discusses his work on the use of insertional mutagenesis and operon fusions for developing *Clostridia* and methanogens, and R. Whittenburg and H. Dalton give an excellent review of the biotechnological potential of methane monoxygenase. In A. T. Bull's presentation on continuous culture he points out the hazards in drawing general conclusions about plasmid stability.

Biodegradation and enzyme technology are the topics for an excellent final section. I. Chibata, a founder of immobilized biocatalyst technology, presents his work on the production of optically active compounds. A. M. Klibanov discusses his discoveries of unconventional catalytic properties of conventional enzymes. For example, glucose oxidase, although very specific with respect to the electron donor, is not specific in regard to the electron acceptor—this versatility can be exploited. The poor solubility in water of many of the substrates in this area of preparative organic syntheses is a problem. It is reasonable, however, to predict that Klibanov's work will be crucial in accelerating the development of enzyme biotechnology. Finally, P. W. Williams et al. describe their experience with TOL plasmids. Research work on the genetic instability of soil microorganisms will be vital for building up this important area of biotechnology.

I think that more attention could have been directed toward bioprocesses that depend directly on photosynthesis. Examples include the use of microalgae and plant cell culture in suspension for the production of chemicals. There is some reference to this field by F. W. Tuominen, Henkel Corp., who points out that the direct capture of light energy by biological systems could well be the most economical route for generating highly reduced chemical products. It is perhaps fair to comment too, that future symposia of this kind might well be designed to illustrate that, in order to arrive at a final, commercially viable bioprocess, engineering research has to be tapped, as well as augmented, to assure a rational and efficient scaling-up.

Although the volume has few typographical errors, on p. 409, Table I and Fig. 1 are mixed up, and on p. 279, liposomes and lysosomes are confused due to a spelling error. In general, it is a well-edited and worthwhile book to possess.

Ruxton Villet, Ph.D., is director of the Association pour la Recherche en Bioenergie Solaire, Saint Paul lez Durance, France.

ERRATUM

In the October issue, the editor of the *Biochemical Engineering and Biotechnology Handbook* is Bernard Atkinson, not Aikens.