Editorial

Analysis of Instrumentation Capabilities and Needs for Biotechnology at Land-Grant Institutions

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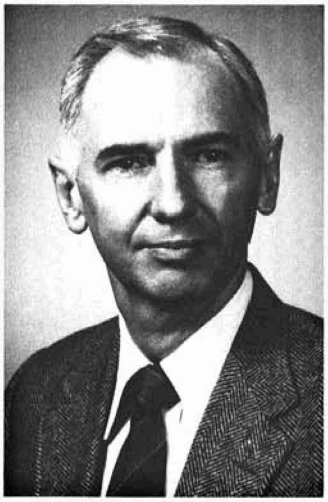

Whether we are involved in applied or fundamental research, most of us would agree that biotechnology—the integration of techniques from agriculture, biology, chemistry, engineering, and molecular biology—is one of the most dynamic areas in science today. The methods of biotechnology are unprecedented in their power for identifying and manipulating individual genes (and their products) responsible for biological form and function.

Many of the techniques used in biotechnology have intensive requirements for modern instrumentation. There is a growing concern, however, about instrument obsolescence at research institutions throughout the United States, including the land-grant universities. But how big is the problem within the land-grant system? Do we have unique needs that differ from those of non-land-grant institutions?

To answer these questions, the Biotechnology Committee of the National Association of State Universities and Land Grant Colleges (NASULGC) sponsored on-site surveys at 13 land-grant institutions to assess instrumentation capabilities and needs for application of biotechnology in agricultural science. For comparative purposes, three institutions were visited in each of the four regions of the United States representing agricultural experiment stations with: 1) fewer than 100 total full-time-equivalent (FTE) scientists, 2) 100–200 total FTE scientists, and 3) more than 200 total FTE scientists. Prior to the on-site visits, a detailed questionnaire concerning age and cost of maintenance for on-site instruments, instrument needs, consumables, personnel needs, facilities, etc., was mailed to each institution. The questionnaires were distributed to principal investigators (PIs) doing research in the area of biotechnology. Discussions were held with over 325 PIs and numerous department heads, deans, and vice-presidents of research. Laboratory and support facilities, primarily as required to properly house instrumentation, were also examined. The major findings were as follows:

Mean age of the PIs' *instruments* was 8 years. These older instruments (e.g., high-performance liquid chromatographs, electrophoresis units, scintillation counters, spectrophotometers, ultracentrifuges) require much more maintenance than newer instruments. PIs reported that replacement was very difficult for instruments costing between $10,000 and $75,000. Replacement was also difficult for PIs at mid-career or moving into biotechnology from another field of research.

There was no uniform mechanism to meet the cost of *maintenance* and *service* of instruments. Annual service contracts averaged $1,500 for instruments such as ultracentrifuges, liquid scintillation counters, and ultraviolet spectrophotometers and $6,000 for mass spectrometers, cell sorters, and nuclear magnetic resonance (NMR) spectrometers. Service contracts and costs for new instruments averaged 20–25% of the capital cost per annum.

Start-up costs for a new PI in biotechnology ranged from $150,000 to $250,000. Most new PIs came with a shopping list of instruments needed; the list was nearly the same regardless of discipline (i.e., most were common pieces). Even with such a list, PIs anticipated sharing instruments that were owned by others.

Initiation of new faculty positions in biotechnology in many departments typically required extensive *renovation* of laboratory facilities. Laboratory renovation costs ranged from $70,000 to $200,000 because of poor environmental controls, inadequate electrical supplies, and poor hood and ventilation systems. Facilities most commonly needed (or requiring remodeling) were greenhouses, growth chambers, tissue culture rooms, fume hoods, animal facilities (large and small animals), and photographic darkrooms.

It was obvious that *centers* of sharing were necessary for special pieces of instrumentation (e.g., mass and NMR spectrometers, electron microscopes, cell sorters, DNA and protein sequencers and synthesizers). Dedicated facilities and operators were usually essential to proper use of these instruments.

For acquisition of new instruments, most PIs opted for a *competitive grants program* instead of block grants. A categorical grant program was favored, i.e., for instruments only and utilizing a short proposal form of 2–3 pages, with costs for service and maintenance included in the proposal, possibly with matching funds from the state. Some PIs suggested earmarking part of the Hatch funds for instrumentation.

Ultimately, many of the results from fundamental research in biotechnology will find application in the agricultural enterprise, but *farm equipment needs* (and costs) for such things as mechanical harvesters are also great and the equipment in use is equally obsolescent. Because of the high costs of biotechnology programs and the need for expensive equipment in the more applied programs, competition for state funds is often keen. Consequently, a number of *hard questions* need to be asked: Is there a critical mass of scientists and funds required to do competitive research in biotechnology? If so, will some institutions lack this critical mass? Should every land-grant institution try to develop a competitive program in biotechnology? There are no easy answers!