JANUARY 2003 Commercial Properties PUBLICATION 1599

A Reprint from *Tierra Grande*

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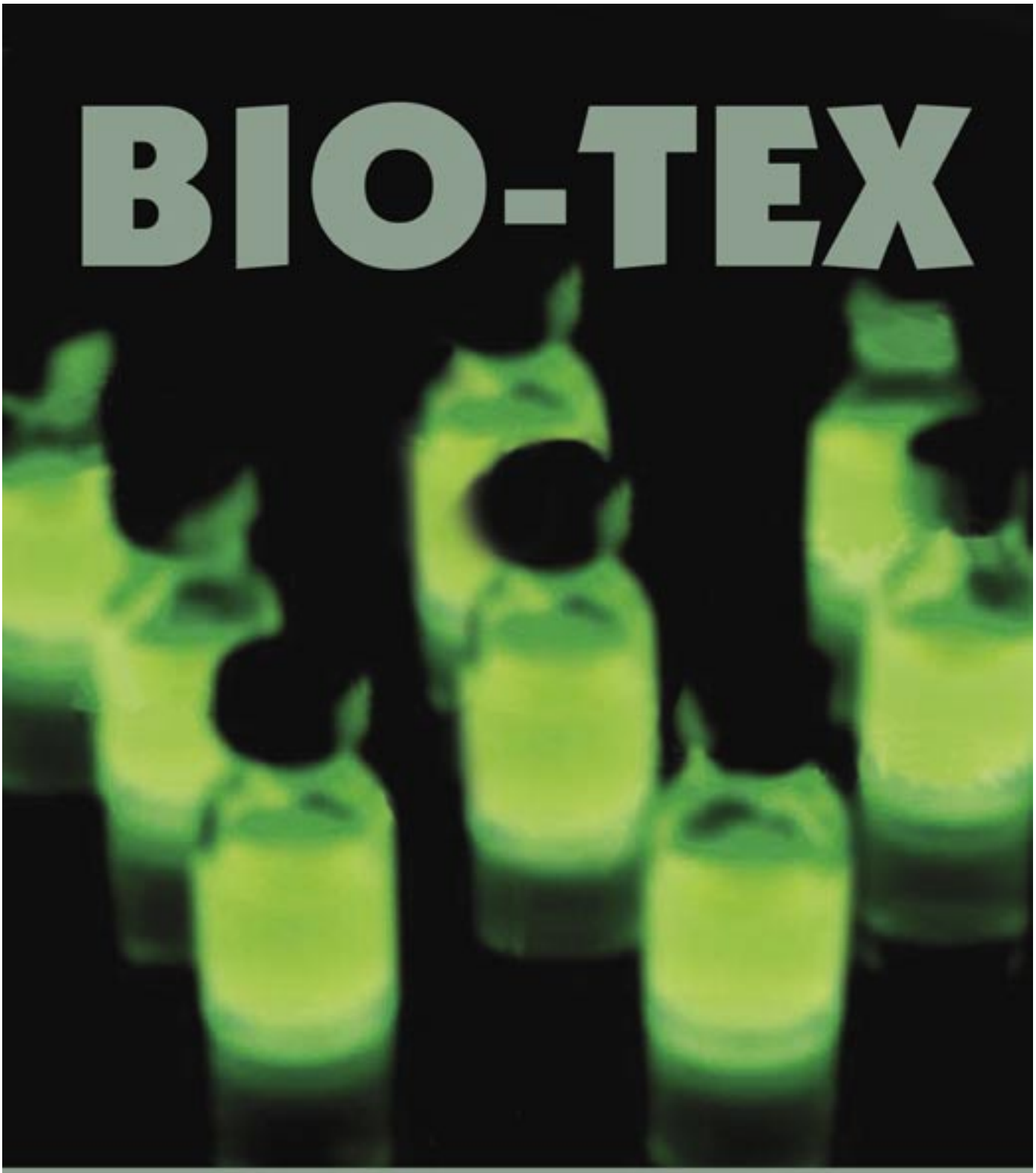


By Harold D. Hunt

LEXICON GENETICS (left) and Sigma Genosys were founded in The Woodlands and continue to operate there. Growing Texas into a biotechnology hub on par with Boston and San Francisco will require cooperation between medical schools, university research centers and community economic development programs.

Money (lots of it). The best facilities. Topflight personnel. Excellence in the front office. And more money. These could be what Texas needs to field a winning NFL team.

But forget football. A tougher competition is under way. Texas is tackling 41 other states that want to become the next great biotechnology hub. At stake are hundreds of new jobs, many of them high-paying. What will it take for Texas to win the Super Bowl of biotechnology job creation?

Biotech Business Boom

Biotechnology has many definitions. One is "the use of cellular and molecular processes to solve problems or make products." Firms that use cells and biological molecules for applications in medicine, agriculture and environmental management fall within this definition.

In less than 30 years, the biotechnology field has grown from a handful of small firms to more than 4,000 companies worldwide. Direct global employment in biotech is nearing 200,000 in publicly traded companies alone, with more than two-thirds of those jobs located in the United States.

The number of biotechnology discoveries has multiplied as well. According to the industry's advocacy group, the Biotechnology Industry Organization (BIO), 70 percent of biotech medicines on the market today were approved within the last six years. More than 350 biotech drug products are in clinical trials.

A recent study by Ernst & Young (E&Y) stated that Texas' publicly traded biotech firms reported almost $103 million in revenues, spent $196 million on research and development and employed more than 1,500 in 2001. E&Y determined that each new biotech job leads to the creation of an additional 2.9 indirect jobs.

However, not all biotech statistics are positive. Although the E&Y study shows that earnings in publicly traded U.S. biotech companies have tripled to more than $24 billion since 1992, the companies also suffered a net loss of $4.8 billion in 2001. A little more than $198 million of that loss was attributed to Texas-based publicly traded biotech firms. Fewer than 70 of the 342 U.S. publicly traded biotech firms are profitable.

Failure rates for new biotech drugs are extremely high. Typically, only five in 5,000 biotech discoveries make it to the clinical trial stage; of those five, only one is granted approval by the Food and Drug Administration for human use.

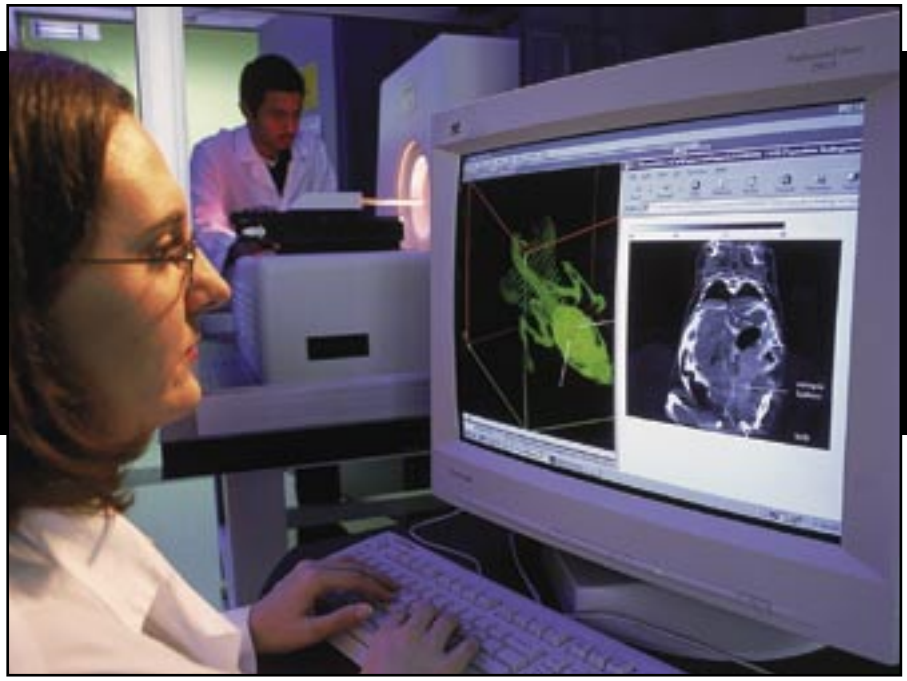
The high drug failure rate translates into a high rate of failure for biotech firms. Companies spending years to get their first drug on the market may not have the resources and additional new discoveries to continue growing. About 80 percent of biotech start-ups fail within three years.

The Brookings Institution reports that development of a new biotech drug may take five to 12 years from initial discovery through commercial production. E&Y reports that total cost to develop one drug can run as high as $800 million. According to Mark Levin, CEO of Millennium Pharmaceuticals, leaders in the biopharmaceutical industry must be able to introduce three to five drug candidates each year to be successful long-term.

Importance of Star Professors

The path to successful commercial biotechnology development is fairly well documented (see figure). New discoveries begin almost exclusively with what those in the industry refer to as "blue sky" academic research — research conceptualized and carried out by world-class scholars with no restrictions on creativity or finances. These "star" professors usually gravitate toward prestigious university-affiliated medical schools where they are assured of generous funding and access to a large number of graduate assistants.

Where star professors locate is particularly critical because of their value to commercial biotech firms. A report by the Dallas Federal Reserve indicates a correlation between published academic articles and commercial development. For every five articles coauthored by academic stars and a commercial firm's scientists, five more biotech products are in development, 3.5 more products are on the market and 860 more people are employed in the industry.



TURNING A BRILLIANT IDEA into a marketable biotech product takes time, money and experienced management, not to mention high tolerance for risk.

Several factors can attract star professors to a particular location. Money is an obvious incentive. Recent estimates indicate it takes as much as a $4 million endowment, a $500,000 lab facility and a staff of 16 postdoctoral medical students in addition to the professor's salary of around $400,000 per year to generate any meaningful interest.

Working in proximity to other star professors may be just as important. Dr. Jonathan Graff, an assistant professor of molecular biology who is working on a cure for colon cancer at the University of Texas Southwestern Medical Center at Dallas (UTSW), says he was drawn to UTSW by "the opportunity to work around so many Nobel laureates." Four Nobel Prize winners in medicine and chemistry are resident at UTSW; Rice University has two and the University of Texas Health Science Center at Houston has one.

For some star professors, quality of life may be the deciding factor. When money is ample and choices numerous, amenities such as quality schools, low cost of living and a pleasant climate may steer the decision.

Keeping Technology Local

The bridge between academic research and a commercially viable product is known as tech transfer. Research institutions' tech transfer offices process patent applications and negotiate licensing agreements with commercial firms. Tech transfer officials also consult with venture capital specialists and decide whether patents should be kept in-house or licensed out to mature biotech or large pharmaceutical corporations.

Retaining the newly discovered technology locally is key to building a strong biotech base. If the technology is sold, research and production typically move to one of a handful of biotechnology regions or "clusters" on the East or West Coasts.

Some suggest that the best chance for developing viable biotech clusters in Texas will come from homegrown talent. Lexicon Genetics, which garnered national attention with its discovery of the so-called "fat gene" that keeps some mice fatter than others despite being fed equally, is a prime example.

"Lexicon Genetics, Texas' largest biotech firm, and Sigma Genosys, a subsidiary of global chemical giant Sigma Aldrich, were founded in The Woodlands," says Damon Palermo, development director-Research Forest for The Woodlands Operating Company. "They have stayed here because both company presidents are from the Houston area and consider the business environment conducive to start-ups and mature biotech firms alike."

Although relatively low by national standards, income from Texas' life science intellectual property has been increasing. The Dallas Fed reports that the figure grew from $4.2 million to $25.6 million between 1993 and 1999. More recently, Dr. Dennis Stone, vice president for technology development at UTSW, says that the medical center received $10 million in revenues from patents and licensing activities in one year.

Incubators Help Cash-Poor Firms

If the technology can be retained locally, a small start-up company will usually be formed and moved to an "incubator" facility where testing begins. Incubator lab space is expensive, possibly costing as much as $350 per square foot to construct, including finish-out. Because obtaining traditional financing for such specialty space is difficult for cash-poor start-ups, universities often serve as the "mother ship" by purchasing and administering the incubator space.

Start-ups typically look for expansion potential and lease flexibility at this early phase in the development process. Incubator facilities usually range from 5,000 to 25,000 square feet.

Start-up businesses with discoveries that show promise need a good business plan to obtain seed money (also called "angel financing") and advance to the next stage of the process: developing a commercially viable product. Incubators in mature biotech clusters have an advantage over those in Texas because they are often located near big pharmaceutical firms that can offer business support services (for example, assistance in writing a business plan) that fall outside the technology creator's expertise.

The fledgling company now moves toward conducting clinical trials. Venture capital and expert business management are critical to success at this juncture. Continued success may lead to an initial public offering, which allows capital to be raised in the public securities markets, but at this point, start-ups depend on money invested by venture capitalists with experience in biotechnology.

At this stage, companies need their own commercial space, with requirements ranging from 10,000 to 70,000 square feet. They now must lease space from private developers.

Mature biotech clusters such as San Francisco or Boston have created sufficient synergy to profitably develop, lease and re-lease high-end laboratory space. In Texas, however, the higher likelihood of not finding a replacement biotech tenant that can afford to lease the space makes investment in such properties much riskier. Some suggest constructing commercial biotech labs away from major medical centers, where development costs are high. Both developers and start-ups could benefit from the lower real estate costs.

After successful clinical trials and approval by the FDA, viable discoveries advance to the pharmaceutical production stage. Major pharmaceutical manufacturers are large employment generators. None have facilities in Texas.

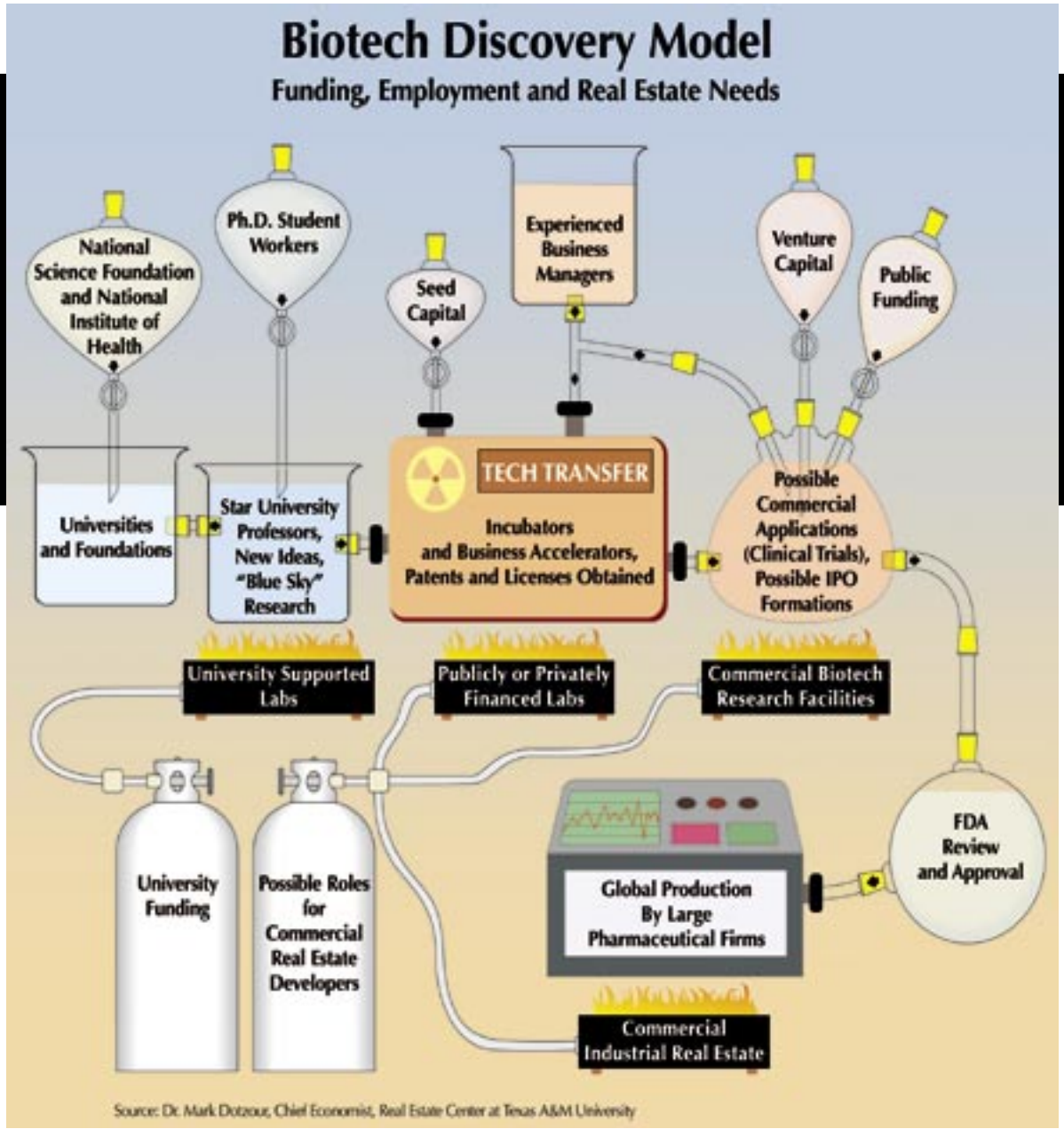
Challenges and Opportunities for Texas

The extremely successful East and West Coast biotechnology regions have built their success on three strengths: well-funded research institutions, abundant venture capital and topflight business management. They also enjoy favorable business climates, highly educated workforces, solid real estate expertise and a host of business accelerators (organizations that smoothly move biotech discoveries through the research pipeline to the commercial production stage). Groups interested in creating a successful biotechnology cluster in Texas must attempt to evaluate prospective locations in terms of these factors.

Biotechnology experts and several published reports indicate that Texas is especially weak in venture capital funding. The Dallas Fed reports that of the $752 million in venture capital funding invested in the U.S. biotechnology industry in first quarter 2002, Texas received only $14 million (1.8 percent).

Texas also has been slow to develop good business accelerators and business management talent. Most major cities in the state now have established local business accelerators, but competent biotech business managers are still scarce.

Governor Rick Perry took steps to improve the business climate for biotechnology during the last legislative session by



setting up four special committees and securing $800 million for improving life science research and commercialization activities in the state. The committees address the critical areas of capital formation, research funding, technology transfer and workforce concerns.

Although Texas is not currently benefiting from the biotechnology boom to the extent that California, New York and Massachusetts are, some insiders believe the state is only one major discovery away from dramatically improving its standing (see related article). Lexicon Genetics Executive Vice President and CFO Julia Gregory sums it up philosophically. "Sometimes" she says, "you have to stand in the path of luck to get lucky."

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Interview with Warren Huff

Warren Huff is a venture partner with StarTech Medical Ventures and founding CEO of a Texas-based biotechnology company, Reata Discovery. Reata was formed to develop medications for cancer and neurodegenerative disease using technology developed at the University of Texas Southwestern Medical Center at Dallas. Huff recently moved back to Texas from Boston where he founded and took public a biopharmaceutical company that developed drugs to treat diabetes and obesity.

Q: A recent Brookings Institution study concludes that no Texas cities currently have the entrepreneurial and financial capacity needed to consistently generate significant numbers of new biotechnology-related businesses. Would you agree?

HUFF: It takes three components to make biotechnology successful. You need world-class biological research, seasoned executives-entrepreneurs with pharmaceutical or biotech backgrounds and venture capital experienced in making biotech investments. Texas is deep in world-class biological research and ranks with the top four or five biotechnology centers in the United States on most important measures. However, the state lacks seasoned executives from the biotechnology or pharmaceutical industry with critical drug development skills such as clinical and regulatory experience.

As far as venture capital, the leading biotech venture firms are based on the East and West Coasts, and they like to invest in companies located near them so they can be actively involved. That makes it much easier to get deals funded in Boston or San Francisco. Texas has not been successful developing biotech to date because, for the most part, it has produced companies with limited, early-stage technologies that could not attract funding from these investors.

While I agree with the challenges identified in the Brookings report, I disagree with the conclusion that Texas cannot develop its share of biotech companies. I believe that Texas can attract capital for biotechnology if it produces companies that have deeper and stronger technology platforms than the investment opportunities on the East and West Coasts.

Texas certainly has the research base for this and can assemble world-class projects that can attract top-tier venture investment. After Texas produces one or two high-profile successes, it will not be difficult to attract sustained venture capital and management resources.

Q: Governor Perry has established a Council on Science and Biotechnology Development. What do you think of state government involvement in developing a viable biotech industry?

Huff: I think state government can play an important role, and the governor's council has developed some very good recommendations. The technology transfer process in Texas has been hampered in the past by bureaucracy. It is subject to many rules that have prevented state government and university systems from proactively facilitating establishment of the biotech industry.

The environment has been improving in the last year or so, however, and that effort needs to continue. Also, state government could take steps to help biotech capital formation. For example, a portion of state retirement funds currently get invested in East and West Coast venture funds that do not make any Texas investments. These funds use Texas money to create California companies to sell products produced with technology discovered in Texas. We should remedy that by having some of these funds cultivate Texas investments.

Q: What can be done to improve our state's competitive position in relation to the top biotech regions?

Huff: Fostering more cooperation between the major medical schools in the state could give us a huge boost. The whole state should be viewed as one region for biotechnology development instead of several self-contained clusters. In this way, Texas cities could play off their strengths.

Very specialized, networked clusters could be created across the state. For example, a cancer project could involve research in Dallas and clinical studies in Houston. Other cities could contribute their specialized functions as well. We will need all Texas resources working in cooperation to develop this industry, even though there is no history of such cooperation here.

Q: What biotech-related opportunities are available for cities without a medical school nearby?

Huff: Many services are required to support biotech research. For example, laboratories use an array of chemicals, instruments, equipment and computers that must be manufactured, constructed or distributed from somewhere.

Labs also use special animals that are produced for testing. These animals have to be bred, housed and cared for. There are many opportunities for schools to specialize in the training of laboratory technicians, veterinary technicians and others.

Q: Any final thoughts?

Huff: I believe we're on our way to experiencing in biotech what we have experienced in information technology since the 1970s. I expect to see technological advances and discoveries in the years ahead that could significantly change the way we treat human disease. This is an exciting time to be involved with biotechnology in Texas.

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Tierra Grande (ISSN 1070-0234), formerly *Real Estate Center Journal*, is published quarterly by the Real Estate Center at Texas A&M University, College Station, Texas 77843-2115. Subscriptions are free to Texas real estate licensees. Other subscribers, $20 per year.