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BRAIN WORK

Industry's urge to build on breakthroughs in neurotechnology could be a boon for business-minded scientists, says **Virginia Gewin**.

The brain may soon be even bigger business. Better treatments have long been needed to address Alzheimer's disease, chronic pain and depression. Now, breakthroughs in brain imaging, neuroinformatics and neurogenesis are creating an industry that is eager to lure cutting-edge academics. Diagnostics, products, brain-stimulation treatments and, above all, drugs are being designed to meet the ever-growing demand for treatment of neurological disease. Scientists with a knack for neuroscience and an interest in business could benefit.

Last year, global neurotechnology industry revenues rose 8.3% to US$130.5 billion, says NeuroInsights, a market-analysis firm based in San Francisco, California. Its *Neurotechnology Industry 2008 Report*, which profiled 500 public and private companies, divided the industry into three sectors: neuropharmaceuticals, neurodevices and neurodiagnostics. In 2007, venture capitalists invested a record $1.77 billion in budding neurotech firms (see graph). Drug companies such as AstraZeneca and Pfizer are investing heavily in developing treatments for diseases of the central nervous system (CNS).

"The conditions are ripe for neurotech to emerge as biotech did in the 1970s — if the economic downturn doesn't quash the momentum," says Christopher deCharms, chief executive of Omneuron, a neurotech company based in Menlo Park, California.

Major hurdles do remain. The global credit crisis is likely to have at least a short-term impact on investment and venture capital. And clinical trials for potential CNS treatments are notoriously difficult, expensive and prone to failure. There is reason for positivity, though, as some in the industry have already started to hedge their bets by increasingly pursuing unconventional collaborations with academia and government. The aim is to take advantage of academia's early-stage research and development (R&D), which is costly but necessary for better treatment design. Such arrangements should afford neuroscientists new types of career opportunities.

Sten Linnarsson: Karolinska graduate and entrepreneur.

Demand for new therapies is the primary reason for optimism at Medtronic in Minneapolis, Minnesota, according to Lothar Krinke, its vice-president of business development. Medtronic is developing deep-brain stimulation devices, the latest ones for epilepsy and depression. The company is increasing its workforce by roughly 10%, Krinke says. In particular, it wants to strengthen preclinical expertise as it expands its R&D. St Jude Medical, a neurotechnology company established by the renowned hospital in St Paul, Minnesota, is recruiting scientists, clinicians and engineers with device experience as it expands its own electrical-neuromodulation business. It hopes to use deep-brain stimulation to treat depression. Omneuron is hiring scientists to help turn real-time brain imaging into therapies — such as learning how to use cognition to 'turn off' brain states that cause chronic pain.

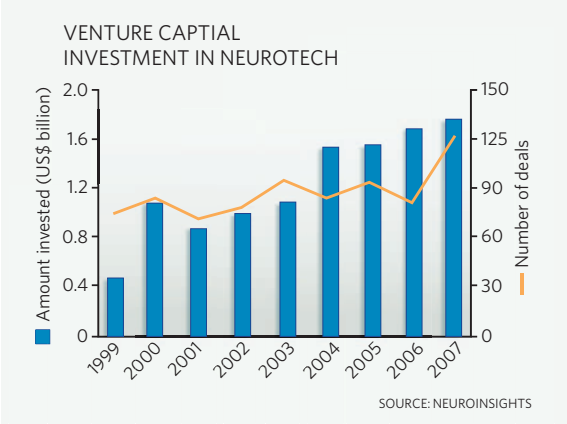
Search for talent

The budding area of neurogenesis research, meanwhile, has prompted drug companies to look to start-ups and academia for talent, says Dan O'Connell, venture capitalist at NeuroVentures in Charlottesville, Virginia. O'Connell calls the development of small molecules to encourage neurogenesis — in which endogenous stem cells mature into neurons — a "breakthrough area". Swiss-based drug giant AstraZeneca announced last month that it will collaborate with Columbia University's René Hen to explore novel neurogenesis-related depression and anxiety treatments.

Also in demand is expertise in the regulatory and clinical-trial arenas. "Ideally, we want to recruit those scientists in pharma who are frustrated and tired of the slow pace and want to come and work in a smaller company," says Ulf Ljungberg, chief executive of NeuroNova, a neurogenesis company in Stockholm, Sweden. But, he adds, most of the company's potential employees come from academia. St Jude Medical is

looking for scientists who have experience with the US Food and Drug Administration, an example of an ever-changing regulatory environment.

One company specializing in psychiatric patient evaluations and therapy responses, MedAvante, is recruiting people with expertise in clinical-trial design and statistics. MedAvante, based in Hamilton, New Jersey, builds assessment methodologies in an effort to improve the design of clinical trials for potential CNS treatments, which often show poor results. For example, a study of dozens of clinical trials for antidepressant treatments found that half the tested drugs failed (A. Khan *et al. Psychol. Med.* **35,** 743–749; 2005). A $20 million investment by Goldman Sachs in July will help MedAvante expand to meet demand from companies seeking to test drugs, by recruiting PhD clinical psychologists and senior scientists.



Head wins over heart

Another way companies hope to reduce the risk involved in developing neurotech products is through translational research, which is receiving a lot of industry interest — and funding. Although the drug industry overall is experiencing job cuts, neurotech-based research is a relatively bright spot. For example, Pfizer recently dropped its cardiovascular-disease efforts while increasing CNS research. "Big pharma is desperate for new products," says Scott Reines, recently retired senior vice-president, of Johnson & Johnson's CNS/Pain Center of Excellence.

Lennart Mucke, director of the non-profit Gladstone Institute of Neurological Disease in San Francisco, says companies that have been ineffective at producing CNS drugs realize they need to do more risky in-depth R&D on conditions and pathways, to come up with more rational drug designs. "Partnering with academia can mitigate that risk," he says. To facilitate this, Mucke says, Gladstone is recruiting scientists to work at the academic–industry interface in its Center for Translational Research. This was set up in 2006, in partnership with Merck, to find therapies for Alzheimer's, Parkinson's and other diseases. Its work builds on Gladstone's efforts to develop drugs targeting apolipoprotein E4, the main genetic risk factor for Alzheimer's.

Paul Matthews, head of GlaxoSmithKline's Clinical Imaging Centre at Imperial College London, says GlaxoSmithKline invested close to £50 million (US$80 million) in Imperial's academic health centre to foster a seamless partnership between industry and academia. He is seeking four experienced imaging scientists to help develop the use of imaging in evaluating molecules as potential neurological treatments. Few imaging specialists have experience in neuropharmacology, however — yet another reason to form partnerships with leading academic health centres.

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Ed Boyden: business skills.

Entrepreneurial skills give an edge

Neurotech-industry managers are also having trouble finding people with the right business and regulatory knowledge. Last year, neurobiologist Ed Boyden created a course series called Neurotechnology Ventures, at the Massachusetts Institute of Technology in Cambridge. Students on the project-oriented course, which teaches the principles of building start-ups, create a business plan to solve a major problem through neurotechnology. Already in high demand, the series is simulcast to universities in Hong Kong and Taiwan.

In Sweden, the Stockholm School of Entrepreneurship (SSES) offers budding neuroscientists opportunities to explore business options. From one-day networking events to courses that teach business models and financial strategies, the SSES pulls expertise from its four academic institutions, which include the Karolinska Institute. Karolinska graduate Sten Linnarsson lauds SSES efforts, and plans to use his entrepreneurial experience to teach SSES courses. After graduating, Linnarsson started Global Genomics, which he recently sold to Genizon Life Sciences Company in Montreal, Canada. He has found it easy to migrate between industry and academia.

O'Connell advises academics interested in business to start with their local resources — including finding colleagues who have already established industry contacts. Academics with a venture idea should check out the university's tech-transfer office, he suggests. Then he recommends finding venture forums and other ways to network with investors — particularly at major meetings such as those of the Society for Neuroscience.

Linnarsson advises entrepreneurs to be independent for as long as possible. "As soon as a venture partner is brought in to build the business, a process begins that takes away some of the entrepreneur's control," he says.

Given the ongoing economic downturn, such efforts may be difficult. But the need for brain therapies should provide opportunities in the long term. James Cavuoto, editor of *Neurotech Reports*, a newsletter based in San Francisco, remains sanguine. "Even the most pessimistic among us think this is a sector that is somewhat immune to the overall economic climate," he says. ■

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