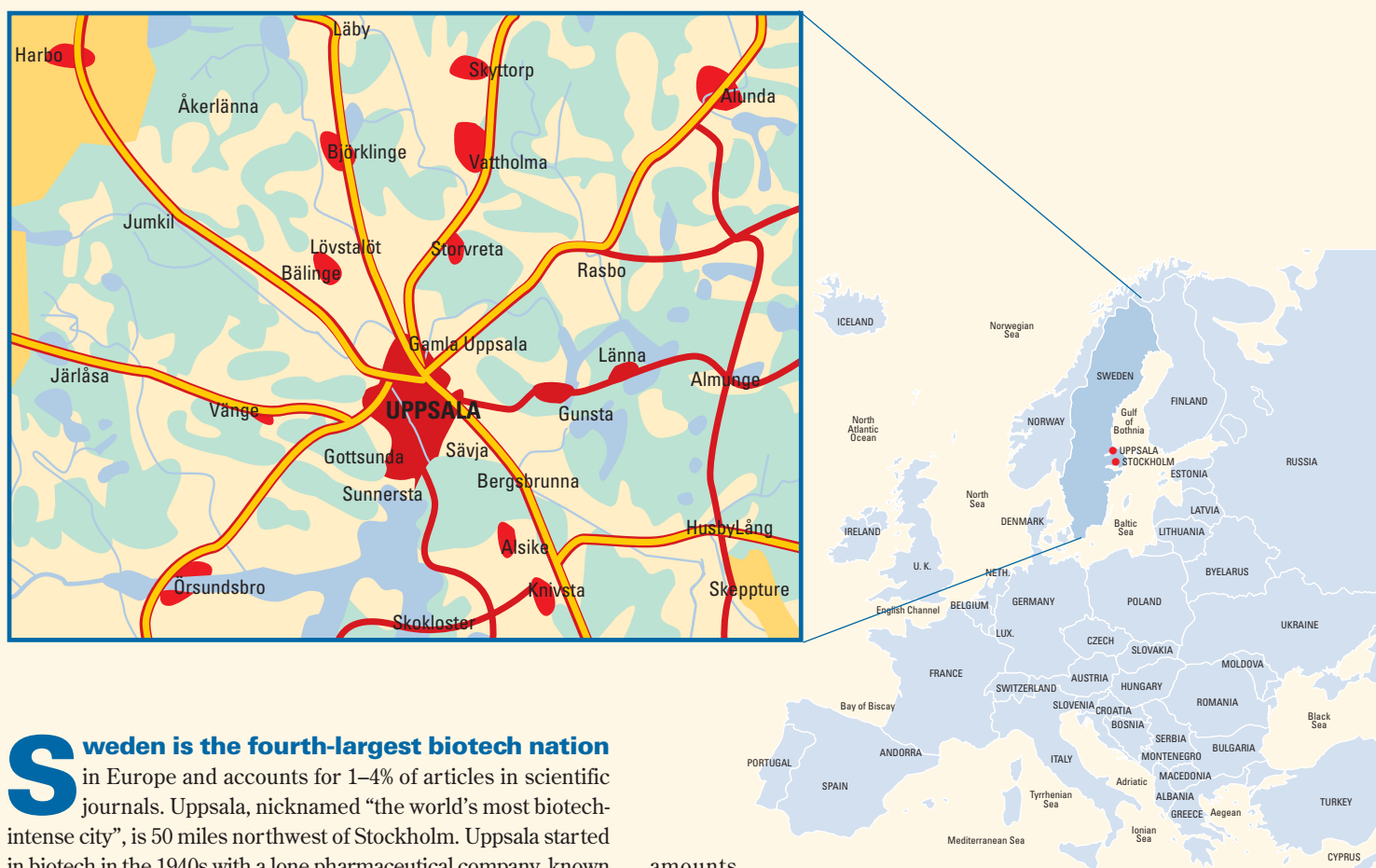


# The Biotech Heart of Sweden

*Second in a series covering the “hot spots” of biotech research and business around the globe.*

BY FELICIA M. WILLIS



**S**weden is the fourth-largest biotech nation in Europe and accounts for 1–4% of articles in scientific journals. Uppsala, nicknamed “the world’s most biotech-intense city”, is 50 miles northwest of Stockholm. Uppsala started in biotech in the 1940s with a lone pharmaceutical company, known then as Pharmacia. Since that time, the company has made many changes, including merging with Upjohn, forming a biotechnology products joint venture with Amersham, and being acquired later by Pfizer. Although many other companies are in Sweden now, Pharmacia laid the groundwork for the upsurge of biotech. According to information from Uppsala BIO, 8% of Uppsala’s workforce is employed in biotech.

The first Swedish biotech companies made products for their local market. The modern R&D-based pharmaceutical industry began to emerge in Europe during the 1940s and 1950s, but only in the 1960s did Swedish pharmaceutical companies begin to invest large

amounts of money in research and product development. This trend continued during the 1970s, when the passion that Swedish companies felt about R&D became known internationally. In the early 1980s, the Swedish endeavor began to increase rapidly, and it grew at an average annual rate of about 20% during the next 20 years. The developments have been based on a series of products that were successful in the international market. Products range from the growth hormone Genotropin to a substance used to make eye surgery easier, called Healon, both of which were marketed by Pharmacia.



**A growing concern.** Sweden has seen constant growth in both the number of biotech firms and their size.

### Campus crawl

It is no surprise that Sweden's historic schools concentrate a great deal on biotechnology. One of the main institutions of higher education is Uppsala University, which offers a rich tradition of innovation. This school, founded in 1477, is the oldest university in Scandinavia. Its researchers have been honored with eight Nobel Prizes, in chemistry, physics, and medicine. One of the best-known Swedes, Carolus Linnaeus (1707–1778), wrote *Systema Naturae* and showed the scientific world that plants could be categorized on the basis of their reproductive systems. Theodor Svedberg (1884–1971) was an assistant in the Chemical Institute at Uppsala in 1905 and was elected Professor of Physical Chemistry in 1912. Svedberg, for whom the svedberg unit of centrifugation was named, won the 1926 Nobel Prize in Chemistry for his research on disperse systems.

Another prominent member of the Uppsala community was Arne Tiselius (1902–1971), the first biochemist at the university. He contributed to the development and improvement of electrophoresis, chromatography, phase partition, and gel filtration. In 1948, Tiselius won the Nobel Prize in Chemistry for his development of electrophoresis.

But the innovative spirit of these institutions is not merely historical. In 1997, researchers at the Royal Institute of Technology in Stockholm formed the company Pyrosequencing to commercialize their new technology for high-throughput DNA sequencing. In 1984, scientists from Pharmacia, the Linköping Institute of Technology, and the Swedish National Defense Research Institute (FOA) were brought together to create Pharmacia Biosensor AB, which became Biacore AB in 1996. And in 2000, Quiatech AB, which specializes in DNA-based technologies, was founded on the basis of work from the Rudbeck Laboratory in Uppsala.

### Government support

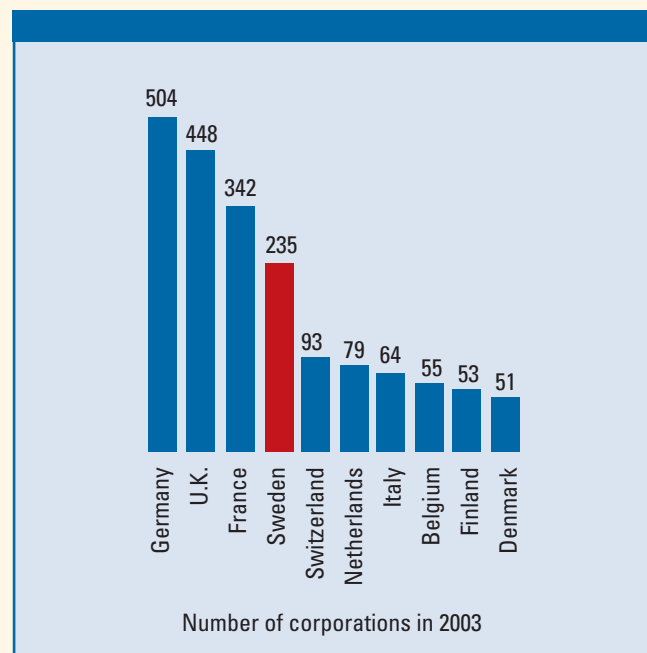
The Swedish government has created a regulatory framework that

has proved useful. In 1996, Sweden and the other European Union member states took an important step by signing the Council of Europe's Convention on Biomedicine and Human Rights. The Swedish national legislature, passing laws on biobanks and the ethical review of scientific research, is following this agreement. Previously, the Swedish Research Council, which is a government agency and the principal funding body for research in Sweden, initiated a broad-based examination of the ethical and legal aspects of the promising but controversial research being carried out into stem cells. The review resulted in new rules and guidelines for research in this field. A special committee is currently examining the question of genetic privacy and will propose new legislation for the management of genetic information in the health care sector. The Swedish Trade Council is a partnership between the Swedish government and the Swedish industry to promote, support, and create opportunities for Swedish exports.

### Biotech buildup

Biotechnology companies are found mostly in Sweden's metropolitan areas and in cities with large universities conducting a great deal of medical research. In 1999, Sweden had roughly 140 small- and medium-sized biotech companies. Smaller biotech companies that were part of this sector were also active in such industries as agriculture and food processing. Most of the companies considered small in 1999 had fewer than 200 employees, but in fact, almost 50% had fewer than 5 employees. The number of small- and medium-sized biotech companies is growing fast, and between 1999 and 2001, the turnover of Uppsala companies in this category increased by almost 70%.

Sweden is successful in the biotech supply subsector and is the home of one of the world's leading biotechnology research suppliers, Amersham Pharmacia Biotech AB (now Amersham Biosciences).



**The big four.** Sweden is rapidly approaching France as the third-largest European center for biotech.

The company supplies biotechnology systems, products, and services for research on genes and proteins, the discovery and development of drugs, and the manufacture of biopharmaceuticals. In 1999, it had 1130 employees in Sweden, a 7% increase from 1997 to 1999, while its revenue increased by 64% to \$332 million.

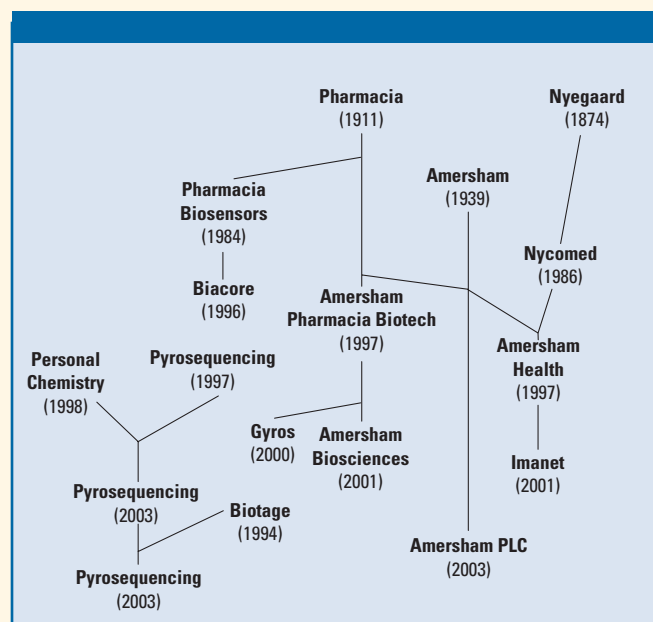
Many smaller companies in the biotech supply arena have the potential for major growth. In 1999, 24 smaller companies covered areas such as bioseparation and biomolecular analysis, biosensors, genomics, bioinformatics, and fermentation equipment. This group of companies together had 259 employees in 1999, an increase of 51% from 1997, and their aggregate revenues increased by about 54%. Other firms include AlphaHelix AB (equipment for adding PCR reagent to samples) and Personal Chemistry (organic synthesis, now part of Pyrosequencing).

Companies producing biological molecules, microorganisms, or cells have as their customers many of the other biotechnology companies, as well as university groups and the food-processing and pharmaceutical industries. Companies in this category had 444 employees in 1999, an increase of 29% from 1997, and their revenues rose by 73% to \$90 million. The micro- and small-sized companies had a total of 33 employees in 1999. From 1997 to 1999, the number of employees increased by 14%, and revenues rose 84% to \$4.3 million.

Sweden hopes to attract companies from all over the world to invest in biotechnology there. The country looks forward to obtaining the financial strength required for the future growth of the industry. Although Sweden's biggest cooperation partner is the United States, a network of new partnerships has been built with countries in Europe.

## Recent activity

The past few years have seen the Swedish biotech arena expand rapidly, with new initiatives and collaborations taking the lead. In



**Biotech beginnings.** Uppsala science has seen growth through technological spin-offs, mergers, and acquisitions.

## Uppsala biopharm companies, suppliers, and government offices

Company	Website
AlphaHelix	www.alphahelix.com
Amersham Biosciences	www.amershambiosciences.com
Amic	www.amic.se
Biacore	www.biacore.com
Gyros	www.gyros.com
Imanet	www.imanet.se
Melacure Therapeutics	www.melacure.com
NeoPharma	www.neopharma.se
NeuroNova	www.neuronova.com
Orexo Pharmaceuticals	www.orexo.se
Personal Chemistry	www.personalchemistry.com
Pharmacia Diagnostics	www.diagnostics.com
Pyrosequencing	www.pyrosequencing.com
Quiatech	www.quiatech.com
Government	Website
Uppsala BIO	www.uppsalabio.com
Uppsala Regional Development Council	www.regionuppsala.com
Uppsala University	www.uu.se

February 2001, Amersham Health announced the formation of Imanet to provide imaging solutions to pharmaceutical development companies. Similarly, to maximize the effectiveness of their strengths, biotherapeutic specialists Melacure Therapeutics of Uppsala and BioFactor Therapeutics of Stockholm merged under the umbrella of Melacure Therapeutics.

In May 2002, microfluidics specialists Gyros AB announced a collaboration with Kratos Analytical Ltd. (part of Shimadzu Biotech) to develop a microlaboratory instrument for the preparation of samples to be analyzed by MS. And this past August, to expand their potential pipeline of products, Orexo Pharmaceuticals acquired recently founded CePeP, a company that specialized in cell-penetrating peptides derived from technologies developed at Stockholm University. Likewise, expanding on their earlier takeover of Personal Chemistry, Pyrosequencing signed a deal with Dyax Corp. to acquire Biotage LLC, a global leader in small-molecule drug discovery purification systems and consumables.

## Leading the charge

Thus, with the rapid expansion of its biotech portfolio and the continuous influx of new technologies and initiatives sponsored by the local universities and government agencies, Uppsala is leading the way in Sweden's biopharm invasion.

**Felicia M. Willis** is an assistant editor of *Modern Drug Discovery*. Send your comments or questions about this article to [mdd@acs.org](mailto:mdd@acs.org) or to the Editorial Office address on page 3. ■