



Biotechnology in Sweden

# The Winner Takes it All

Swedish life science has enjoyed an excellent reputation for more than a hundred years. Since the 1990s, Sweden's emerging biotech industry has pushed the Scandinavian nation into Europe's top five countries for life science.

Has anybody ever heard of ophthalmologist Allvar Gullstrand? In 1911, he was famous: the first Swede to receive the Nobel Prize in Physiology or Medicine "for his work on the dioptrics of the eye". Since then, six of Gullstrand's countrymen have received the prestigious award (the latest to receive it was neuroscientist Arvid Carlsson in 2000). In addition, the Nobel Prize in Chemistry has remained in its country of origin four times.

If you are a natural scientist, you may remember Theodor Svedberg, who developed the technique of analytical ultracentrifugation and became a Nobel laureate in 1926, or Svante Arrhenius, creator of the famous Arrhenius equation (which holds that for every 10°C increase in temperature the rate of reaction doubles). A Swedish scientist founded modern taxonomy (von Linné in the 18th century), invented spectroscopic analysis (Anders Ångström in the 19th century), built the first implantable pacemaker (Rune Elmqvist and Åke Senning in 1958) and developed the best-selling medicine of

the 1990s, the gastric ulcer drug Omeprazole (Astra Zeneca).

A large chunk of the Swedish biotech industry has its roots in a handful of pharmaceutical and medical companies founded at the beginning of the 20th century (including Getinge, Astra, Pharmacia, Gambro and others). There are few countries in the world that have managed the shift from the "old" pharmaceutical industry to the "new" life and biotech sciences in such a smooth manner (the only other similarly successful nation is Switzerland).

## Swedish super troupers

Nowadays, Swedish life science ranks among the top five in Europe and the top ten in the world. According to the Swedish Biotechnology Industry Organization, SwedenBio, about 40,000-50,000 people in Sweden are employed in the life science industry (23,000 of them in biotech firms). SwedenBio is happy to boast that, numbering 800, Sweden has the highest number of life science companies per capita in the world, turning over more than €7 billion.



Swedish chart toppers ABBA, adored throughout the world in the 1970s and 1980s. Swedish biotechnology is following suit.

However, the lion's share of these revenues came from Swedish Big Pharma, primarily AstraZeneca and Pharmacia.

With a population of 9.1 million, Sweden is considerably smaller than Germany (82 million inhabitants), the United Kingdom and France (both 60 million). However, in biotechnology the Scandinavian country is able to compete with these and all other European countries. Sweden's population represents only 1.8 percent of the EU total (490 million) but the country is home to 7 percent of all European biotech companies and 11 percent of public biotech companies, which is the highest ratio in both cases. Sweden has 17 public biotech companies; only the UK and Germany have more.

More important than simply ticking off the number of its biotech companies, however, is to examine a nation's total expenditure on research and development (R&D). Here, Sweden has been consistently ranked below the world's elite. In the *IMD World Competitiveness Yearbook 2007*, which analyses and ranks the ability of nations to create and maintain an environment that sustains the competitiveness of enterprise, Sweden is ranked 9th, with a clear trend towards catching up.

## On and on and on for years

Sweden performed even better in the *European Trend Chart on Innovation*, that stated "that Sweden continues to be Europe's leading country [...] – a position held since 2003. The performance is most striking in terms of [...] Early Stage Venture Capital (some 220 percent above the EU average)."

Sweden's capital, Stockholm, is one of the best places in the world for biotechnology, employing over 20,000 people here.



Of course, every country has its weak points and one shouldn't ignore Sweden's. According to EU experts, the country is below the EU average when it comes to the percentage of university-based research financed by industry, and business R&D investments have continued to fall. That fact, however, didn't prevent *Newsweek* from hailing Sweden as "the best country to be a bio researcher" in a cover story on "the world's best countries" in 2004.

### Money, money, money

Sweden also offers advantages for investors, according to Ylva Williams of the Invest in Sweden Agency (ISA). In comparison to the USA, salaries and the cost of R&D are much lower, she explains.

In addition, Sweden invests considerably more in R&D as a percentage of GDP than all other OECD countries (3.83 percent in 2006). In terms of per capita investment, Sweden's expenditure of €1,200 per person on R&D is the highest in the world.

You would expect that these conditions were ideal for an explosion of biotech enterprise. You'd be right. Blossoming in a fertile environment dominated by the big Swedish pharmaceuticals, AstraZeneca and Pharmacia, numerous biotech start-ups have sprung into being since the mid 1990s. Their number has rocketed to as many as 250 (other sources say 430). Well-established names are among them, including the Pharmacia spin-off Biovitrum (founded 2001) with its 500 employees, drug developer Active Biotech (Scheelevägen, 1997) with its 87 employees, and the specialist in automated mi-

## Technology transfer in Sweden

# Research Applied

How the Karolinska Institutet makes money from state-of-the-art research.



The Karolinska Institutet is one of Europe's largest medical universities and one of the world's best medical research institutions.

The *Institutet* is a leader not only in academic research but also in founding companies, having launched to date around 40 new biotech and medical start-ups. Swedish universities are prohibited by law from taking their own financial risks. So in 1995 the Karolinska Institutet set up a company to look after its commercial operations – the precursor of Karolinska Institutet Holding AB (KIHAB). KIHAB is responsible for the translation of promising

(above) The official Karolinska logo.  
(right) Aerial view of the Karolinska Institutet. Founded in 1810, it is located in Solna (a suburb of Stockholm).

discoveries, made by Karolinska scientists, into lucrative applications. As a subsidiary company of the University, KIHAB's business principally consists of the evaluation of ideas and patents, venture capital, legal advice, project management and incubation. In addition, KIHAB manages shares in the research and development companies that commercially exploit projects and knowledge developed at the KI. For the 2006 financial year, KIHAB reported a profit of €5.3 million, generated by the year's life science and medical start-ups. -WK-



croscopy analysis, Cellavision (Lund, 1994), that employs 45 people.

Stockholm-based Biovitrum, specializing in drugs for obesity, diabetes and inflammation, raised €72 million in 2006 in the second-largest European biotech IPO

of the year. Since then, however, the shares of "one of the largest biopharma companies in Europe" have fallen 38%.

Another Swedish biotech figurehead is Medivir from Stockholm, which, with 100 employees, also belongs amongst Sweden's

largest biotech companies. Medivir develops protease inhibitors for pharmaceuticals. With Lipsovir to treat labial herpes, the company, under former GlaxoWellcome Marketing director Lars Adlersson, has an iron in the fire that could achieve market registration in late 2008.

### Take a chance on me

However, most Swedish biotechnology is considerably younger and smaller. The Gothenburg-based start-up Vivolux, founded in 2004, is "searching biological applications for synthesized organic compounds that combine fluorescence with DNA interaction". Vivolux has such an impressive web presence that one almost overlooks the fact that it employs barely a dozen people and is still looking for venture capital.

What makes the biotech world go round are its movers and shakers, of course. The



**Biovitrum's CFO Göran Arvidsson looks good humoured, despite a dwindling share price.**

another (Biovica) in 2004.

Perhaps Sweden's most prominent biotech enterprise, however, is Biacore of Uppsala, one hour north of Stockholm. Biacore was founded 1984 as a result of the merger of Linköping Institute of Technology and the Swedish National Defence Re-

search Institute. The company specializes in systems for the analysis of protein-protein-interactions and binding affinity. Biacore has always been haunted by the big pharmaceuticals. For many years Pfizer owned a 41% share, until in June 2006 the company was acquired by GE Healthcare for €270 million. At the moment, 275 people are working for this American company with Swedish roots.

Even the Swedish biotech pipeline boasts numerous exciting possibilities. It's a sure bet that foreign companies are keeping their eyes on its 65 clinical and 45 late pre-clinical projects (eleven of them in fairly advanced Phase 3 stages).

Does your correspondent think there's really more to Sweden than elks and herrings? I do, I do, I do, I do, I do...!

WINFRIED KOEPELLE

WINFRIED KOEPELLE

## Location of Swedish biotech

### Springing up like mushrooms

In addition to the main bioregions around Stockholm and Malmö, some smaller centres have developed over recent years.

**Stockholm/Uppsala/Strängnäs** is by far Sweden's most important biotech region (and in addition one of Europe's largest). Astra, Pharmacia and the Nobel prize were all founded here. 250 (58%) of Sweden's biotech companies are located here, employing over 20,000 people. They recruit from dozens of resident academic institutions, including the Karolinska Institute, Stockholm and Uppsala Universities and the Linnaeus Centre for Bioinformatics (with 23,000 students in life science related disciplines). Companies like AstraZeneca, Biacore, Amersham GE, Phadia, Biovitrum, Medivir and SBL Vaccines have their headquarters here.

**Lund/Malmö** is Sweden's second largest bioregion with 15% of the nation's biotech companies, including Active Biotech, Novozymes and Alligator. It is located near the Danish Copenhagen/Öresund region and features academic facilities such as Lund and Malmö Universities and several hospitals, biomedical centres, science parks and incubators.



The **Gothenburg** region has a 14% share of Swedish biotechnology. The resident life science firms (e.g. Nobel Biocare) employ 8,000 people. Important institutions are the Swedish Biomaterials Research Center, the Chalmers Institute of Technology and Sahlgrenska Academy and University Hospital.

**Linköping** is the home of 45 biotech companies (mainly small start-ups) and several academic institutions with a focus on medical topics, such as diagnostics and imaging.

**Umeå** in Sweden's north, is a small biotech region with a fistful of companies and academic institutions (including Umea University and the Umea Plant Science Centre) that employ 1,000 people each.

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(left) Sweden's 430 biotech companies are distributed over five biotech areas (marked as mushrooms). The most important, Stockholm and Malmö, are located on the south-eastern coast of Sweden.