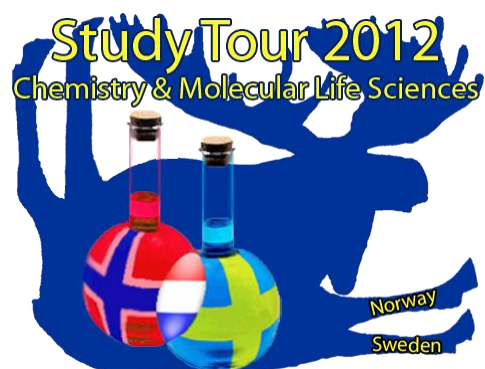


STUDY TOUR 2012

NORWAY AND SWEDEN



April 23rd – May 7th 2012





Strong Chiral Technologies

Development & Supply of Unique Chiral Scaffolds

Combinatorial Library Synthesis

Custom Building Blocks

WWW.CHIRALIX.COM

Your partner in chiral chemistry

Chiralix is a specialist in chiral organic synthesis. We offer a unique range of chiral drug-like building blocks on research-scale, aimed at research laboratories in pharmaceutical companies and all others involved in the Life Sciences industry.

The integration of our proven state-of-the-art technological capabilities in the areas of advanced organic synthesis, transition metal catalysis and biocatalysis, enables us to develop flexible and efficient synthetic routes to diversely substituted chiral molecules, such as specialty amino acids, azido acids, amino alcohols and peptide building blocks.

In addition to our catalog of unique building blocks, we provide high-quality contract research services for our clients in support of their own research efforts. Our services include the custom synthesis of complex organic molecules and the parallel synthesis of compound libraries.



Chiralix B.V.
Toernooiveld 100
6525 EC Nijmegen
The Netherlands

Tel.: +31 24 365 2194
Fax: +31 24 365 2259
E-mail: info@chiralix.com
www.chiralix.com

TABLE OF CONTENTS

| | |
|---|----|
| Preface | 4 |
| Scientific staff | 6 |
| Preliminary studies and retrospective views | 12 |
| Case studies | 23 |
| Program | 31 |
| Daily reports | 33 |
| Committee reports | 59 |
| Financial report | 63 |
| Study tour participants..... | 65 |
| Acknowledgements | 66 |
| Colophon | 69 |

PREFACE

Dear reader,

In this final report of the study tour 2012 to Norway and Sweden you will get an idea how the tour was organized and how much we enjoyed taking part.

The preparations for our study tour started more than a year before we would leave. It all started with picking the destination of our study tour. In the previous years the study tours have had exotic destinations like Canada and Argentina. Unfortunately this is no longer possible with our current budget. We had to find an exciting destination within Europe. We came up with three possible destinations and it was up to all prospective participants to vote. The south European option of Spain/Portugal eventually got only 1 vote, which was slightly regretted by Roland Brock. The Nordic option was the favourite destination among the committee members, although a trip to Hungary would certainly not have been bad either. With only few votes difference, Sweden and Norway was also the favourite study-trip destination according to the voters.

We could not have anticipated on the fantastic outcome of the choice of these countries. The weather was beautiful, the countries were beautiful, the people were nice and the science was excellent.

The hospitality in Sweden and Norway was overwhelming. Everywhere we came the people were enthusiastic about our visit and about the concept of our study tour. We were welcomed with open arms, coffee and sweet pastry. Often we could also enjoy a lunch, which turned out to be a complete (hot) meal. This was very welcome to come through the long days full of lectures and tours.

Of course we did not come to Sweden and Norway for the free meals. We came for science! The primary goal of the study tour is to explore the molecular sciences abroad. Besides this, we could also explore some of the culture, discover the cities and meet with other people. It is fair to say that we succeeded in this. The study tour resulted in something great for all of us. It was a wonderful combination of visiting universities and companies and experiencing the Scandinavian culture. There was a large variety in sciences in the visits we made, and by doing this everyone joining the study tour had something interesting to see in their own field. The level of the science in these countries was excellent, quite above our expectations. During the visits, the enthusiasm of the group was shown by the many good questions that were asked. We also enjoyed the Scandinavian culture in the best way, by joining the very old tradition of Walpurgis Night in Skansen and having a traditional Swedish student party.

The whole committee would like to thank all the people in Norway and Sweden for giving us such a warm welcome and amazing us all with the best of their scientific fields. In the end we have seen and hopefully learned what chemistry and molecular life sciences has to offer us. This trip would not have been possible without everyone who supported us. We would like to thank all of our sponsors and the departments of the universities who gave us case studies for their financial support and making this study tour possible. We also especially would like to thank our two supervisors Roland Brock and Martin Feiters for their big contribution to this amazing trip. Last but not least, we would like to

thank all the participants and our fellow committee members for making this study tour a great experience.

The enthusiasm of the group also spoke from the reunion. Despite we planned it on an (afterwards not so) interesting football evening almost everybody showed up. Martin Feiters had made a quiz which showed how transient our knowledge is. Some of us had trouble with some of the questions, others with all of them!

To not forget the adventures we had, there is this final report in which you can find everything concerning the study tour. We wish everybody lots of fun while reading this!

Luc Depré
Chairman

Merijn Blaakmeer
Secretary

SCIENTIFIC STAFF

Here you will find extensive reports from prof. Roland Brock and dr. Martin Feiters about our adventures and their own experiences during the study tour.

TWELVE DAYS OF SCANDINAVIAN SCIENCE AND HOSTELS – SHOCKS AND PLEASURE

Roland Brock

When I was asked whether I wanted to join the study trip I felt flattered. If students that know me from two courses I teach, do not mind having me around for two weeks, it could not have been so bad after all. Furthermore, what could be better than being a professor while travelling. Having Spain and Portugal during May as one options on the list of travel destinations certainly was a sunny prospect. However, Sweden and Norway were on the list as well and my early warnings that these countries are pricy were taken less relevant than the fact that „most students had already been in Spain and Portugal on vacations“.



Never mind, Stockholm, I knew was a beautiful city with colleagues I would be happy to meet again, and Norway would also be new for me. The preparation started early and overall I had the feel that everything went very smooth, once it had been decided not to leave the organization to a travel agency.

Finally, the day had come and I boarded the airplane to Stockholm. The train to Uppsala was easy to find and a little later I made my way towards the youth hostel. Unfortunately, the hostel was located just underneath an enlarged inset in the map that I had received and once I had arrived at the place where it was supposed to be, the only thing I could find was an ugly commercial building that seemed to wait for its demolition, a school complex and a residential area. I walked around for about 15 min always returning to the rotten building until I finally noticed that the sign reading Hostel was not pointing to somewhere but to the inside of this building. Ultimately, the hostel was not bad at all. I decided to accept common bathrooms as a nostalgic memory of my own experiences of student travel.

Uppsala turned out to be a nice little city, Martin Feiters knew a lot to tell. Martin in general was a very knowledgably tour guide, always very well informed. In Uppsala, also the particular rhythm of this study trip started, that I very much enjoyed throughout the whole journey - a quite relaxed change of company/university visits, tourist attractions and free time. As an accompanying faculty, I never had to think much. I could comfortably rely on the perfect organization by the students.

Very soon, we arrived in Stockholm. I decided that I had misunderstood when I overheard that our accommodation there would be in a basement. But, I had understood well. For a week I would be living in a window-less 6 square meter room at the end of a dark corridor with a shared bath room in which the only place to fit the pyjamas was between the shower curtain and the door. I decided that having wireless was all that I needed and furthermore to enjoy the time in Stockholm. And what followed was a wonderful week with marvellous sunny days, again a very informative programme in one of the world's nicest cities and a memorable dinner with Ülo Langel and Martin and a nice Saturday with my friend Mattias and a beer-outing in the evening.

The week was over soon. I happily said a farewell to my dungeon and was curious to see the landscape between Stockholm and Oslo from the train window. I wanted to learn whether it is true that I would have to pay eight euros for a beer. To my surprise, the capital of the country that gets rich from oil looked much less shiny than Stockholm.

Still, Oslo took me by the beauty of the fjord in front and the woody hills in the back. Being a the university in bright sunshine and seeing the shiny water far away was fantastic. And so the last two days went and I entered the plane back.

Sure, this was not really any teaching obligation for me at all and there would certainly be ways to make use of this unique format of a course and enhance the learning experience. But also, this was not what this was too much about. These were very pleasant two weeks with a very nice group of students that I had known only a little before, a nice reminder of old ways of travel, and many nice talks with the students along the trip. A very pleasant experience.

Tak.

ÅNGSTRÖM, YTTERBY, NOBEL AND BYGDØY – HOW SCIENCE MEETS CULTURE

Martin Feiters

Upon arrival at Stockholm International airport we were immediately confronted with different money (crowns) and writings in an alphabet that was partly unfamiliar. Fortunately one of the first examples in Arlanda railway station, 'spår', revealed its Dutch meaning (spoor) when pronounced correctly. Uppsala 'Vandrarhem' did not look very inviting from the outside, partly because of the reconstruction in progress, but it had a very cosy kitchen and social rooms, with a coffee vending machine in continuous happy hour mode. Spring in Sweden was obviously lagging behind that in the Netherlands by a few weeks, with the river flowing through Uppsala centre looking as if it had only just thawed, and the weather did not brighten up till the late afternoon. Uppsala Domkirke is the seat of the head of the Lutheran Church of Sweden and is the burial place not only of some Swedish kings but also of at least one scientist of international stature: Carl von Linné, who started his academic career in the Netherlands, and gave his name to the Linnaeus building of our university.



The first industrial visit was to the Mecca of protein chromatography: the site of General Electric Health Care, which made its name in the past half century as Pharmacia, the leading producer of column materials for protein purification, along with LKB who manufactured the accompanying fraction collectors and detectors. Parts of the lectures were probably vaguely familiar to the students who followed the Instrumental Analysis course not so long ago ... For our first academic visit in the afternoon the excellent Uppsala public transport took us to the outskirts of the campus to the buildings of the Swedish University of Agricultural Sciences. Here we were received by the Bioinformatics group of Erik Bongcam-Rudloff in their cosy library. There were just about enough seats for us; Erik and his group were standing throughout most of the inspiring mini-symposium which covered a variety of subjects investigated by the group. In the evening the students managed to cook a meal for the group in the kitchen of the hostel.

The next morning the group of prof. Stenbjörn Styring, a former PhD student of prof. Bo G. Malmström from Gothenburg like myself, and his co-workers Karin Stensjö and Reiner Lomoth gave us a kaleidoscopic overview of all their biological, biomimetic, and chemical activities in the research area of photocatalytic hydrogen evolution, and showed us an impressive array of spectroscopic instruments in the cellar of the Ångström laboratory. In the early afternoon we visited the University museum (Gustavianum), which among other things had Celsius's thermometer on display, and contained an interesting anatomical theatre in its tower. Later that day we travelled to Stockholm, where the youth hostel lay partly underground. Not all of the sleeping rooms had windows, but possible difficulties with the longer days/shorter nights were thereby avoided, and the ventilation seemed to be OK.

Breakfast was in a small restaurant across the road, which on some of the public holidays in the following week opened especially for us. The very efficient Stockholm public transport system took us to Karolinska Institutet in some other corner of the city by a direct bus connection. Here we were hosted by prof. Günther Schneider and his group, who welcomed us with Swedish pastry, and even offered a light beer at lunch. We got an impressive overview of all the steps in the elucidation of protein structures by X-ray crystallography and the interpretation of it. In the afternoon we went to the campus of Stockholm University for the first time, for a minisymposium with the Neurochemistry department. Luckily for Luc Depré and me, who gave presentations on behalf of Nijmegen, our host, prof. Udo Längel, reserved his most critical questions for his own students. He then treated the staff to a very generous dinner in a traditional Swedish restaurant. Last thing I recall was one bottle of wine after another being carried to our table ... It was just as well that the taxi driver was familiar with the exact location of our lodgings.

Next morning we were very kindly received in the South of Stockholm by the metallurgic company Sandvik who lead the world by fabricating the hardest ceramic materials in all shapes and sizes. Confronted with this hard-core materials chemistry, I realized that although my own great-grandfather was a blacksmith, I am myself become more interested in metals in more dilute systems. For the afternoon the Tunnelbana took us back to the city centre for a tour of the impressive, beautifully decorated Swedish warship Vasa. Although Dutch-Swedish relationships were somewhat strained for most of the 17th century, Dutch shipwrights supervised the building of this ship which was supposed to be used by the Swedish navy in their campaign against Poland. They must have made some serious error of judgment in the construction of the ship, because it sank on its maiden voyage in Stockholm harbour within a mile of the shipyard, and lay at the bottom of Stockholm harbour, exposed to Stockholm sewage water, for more than 3 centuries until its recovery half a century ago. The conservator gave us an interesting account of all the problems encountered in its conservation, and even asked us for advice. All we could offer was to say that in hindsight, it would have been better to neutralize the acids before fixing the material with a polyethylene glycol resin. In the evening the society of Stockholm science students invited us for dinner in their nice wooden abode on the campus of Stockholm University. The table arrangement ensured a good mix of Swedish hosts and visiting students. The master of ceremonies prompted the singing of a number of Swedish drinking songs to which we reciprocated with the 'Wilhelmus' and 'Zie Ginds Komt de Stoomboot'.

It was a splendid idea to make a tour by boat to Vaxholm on Sunday, and we were rewarded by glorious weather. The boat trip gave us a good impression of the archipelago of islands by which the Swedish mainland gradually dissolves in the Baltic Sea. After exploring the sights of Vaxholm, including its inspiring mini golf course, the study tourists set up in groups to the neighbouring islands. There we found the mine of the village of Ytterby, which gave its name to 4 of the elements first discovered in its minerals. From the hills around the mine we had a splendid view back to Vaxholm

and the other surrounding islands. Even Ytterby is connected to the Stockholm public transport network which took us back to the city.

On Monday we went to the campus of Stockholm University for the last time, this time for a visit to the Arrhenius laboratory. In the morning the Dean of the Chemistry Section explained the structure and funding of Swedish science. It appears that the power of the Dean is much limited by the fact that the Departments that he is supposedly in charge of receive their money directly from a higher level in the University governance structure, much like it was in the Dutch system before the establishment of research and teaching institutes in 2005. For foreign post-docs it is attractive to come and start to work in Sweden since they are exempt of income tax in their first 2 years. The afternoon brought a series of lectures from the Organic Chemistry department, on topics as diverse as hypervalent iodine (by Marien Bouma, our Dutch host, and post-doc in the group of prof. Berit Olofsson), homogeneous catalysis by a representative of the Spanish colony at Stockholm University, and prof. Björn Åkermark, a former collaborator of Stenbjörn Styring, whom we had met in Uppsala.

Some study tour participants had already explored Skansen, the first open-air museum in the world, nicely situated on a mountainous island in the centre of Stockholm, during the weekend. It is amazing to consider that some of the buildings have been brought together from more than 1000 kilometres apart, even from Norway which was still a joint kingdom with Sweden when the museum started in 1891. It was interesting to see some of the native animals of Sweden, like moose, reindeer, bears, wolves, and wolverines, and to be able to taste a moose snack. The evening programme included a very special occasion, the Walpurgis night fire, the largest of its kind in Sweden, surrounded by a programme of traditional and popular music.

The 1st of May brought a different kind of activities to the centre of Stockholm, as socialists, anarchists and other groups that were sometimes difficult to identify held their happenings on street corners or marched over the city squares. We were fortunate that we could get a tour of the Nobel museum on this public holiday, although it was a pity that the special exhibition about Marie Curie was just being disassembled. It would have been interesting to see how the Nobel foundation looks back on her relation with this scientist: she was initially overlooked for the Nobel prize in Physics in 1903 due to an oversight by the French Academy, and when she was later awarded the Chemistry Prize in 1911 they tried to dissuade her from coming to Stockholm to accept it because of the emerging scandal of her *liaison* with a married colleague. Most of the exhibits were information that could also have been looked up on Wikipedia, but some Nobel laureates have donated interesting material to the museum, for example the stroboscopic demonstration of the application of femtosecond laser spectroscopy on the methane molecule from the 1999 Chemistry laureate, Ahmed Zewail.

The next day it was time for a change in money (from Swedish to Norwegian crowns) and alphabet (ø, æ), when the guard of the international train informed us that we were crossing the Swedish-Norwegian border. With some difficulty we found the Anker Hostel in Oslo, where we arrived at about the same time as the Norwegian students we had arranged to meet. They took us for a barbecue in the park with the famous Vigeland sculptures. The weather was almost too good to put on the official study tour shirts, but the sculptures were a good setting for the official group photograph.

Breakfast was provided just down the road from Anker Hostel in a small restaurant which kept rather informal opening times, not quite up to our busy schedule with early morning appointments. Nevertheless we made it in time to the spin-off company Lytix Biopharma, which has an office in the incubator building of Oslo University and explores the application of modifications of biomimetic amphiphilic lipopeptides in cures for infectious diseases and oncology. After almost 10 years in business, the 2 founding inventors John Sigurd Svendsen and Øystein Rehdal still own (a small part

of) their company and do research as its scientific officers. In the afternoon we visited a larger company, Life Technologies (Invitrogen), residing in what appeared to be a large villa in an attractive residential area. Here we had an interesting mini-symposium with lectures both from the company and Nijmegen. Hopefully my 30 min. advertisement for strain-promoted click chemistry from Nijmegen will lead to a more intense commercial interaction between the companies involved.

The next day we were back on the campus of Oslo University for a visit to Cell Biology, where our host Gunnar Dick first explained how studies in Natural Science are structured in Norway. He then gave an introduction to the world of glycoproteins, which was followed by demonstrations of the chromatographic, spectrometric, and microscopic techniques used for their study. Having said goodbye to one of the staff supervisors, Roland Brock, we went for lunch in the impressive National Cancer Hospital. Here we were the guests of the Tumor Biology group where group leader Ola Myklebost and his group members Leonardo Meza-Zepeda, Susanne Lorenz, Eva Wessel Stratford, Else Munthe, and Eivind Honig gave us presentations around the themes of cancer of mesenchymal tissues and personalized cancer medicine, and showed us their laboratory. Towards the end of this symposium the intense programme of two site visits per day started to exert its toll ... We returned to the campus of Oslo University where we found with some difficulty the backyard of the student society's building where they were preparing a barbecue for us. Unfortunately the weather was much worse than two days before, and we withdrew to the student's pub in the cellar. Here a student quiz was held, and for our convenience the questions were read out in English. The context was still Norwegian, however, so it would have been very convenient to have mixed groups of Norwegian and Dutch students ...

With the good weather definitely gone, we went on a very windy and sometimes wet guided walking tour of the centre of Oslo. This started at the Town Hall where the Nobel Peace Prize is awarded every year in December, but unfortunately it was closed to the public because of some ceremonies going on. We walked all the way from Town Hall to the Royal Palace, the impressive Opera and back via the Akershus castle. In the afternoon we took the boat to the Bygdøy museum island, and saw an exhibition of the Viking ships that had been used for burial of important people all around Oslo area, which were excavated in the previous century and brought together here. During this and the next days, I also took the opportunity to visit the museum where Fridtjof Nansen's ice-proof ship 'Fram' (= forward) is exhibited. Not only was it used to explore the Arctic sea, but also to bring Roald Amundsen and his team to Antarctica in their race with the British explorer Robert Scott to be the first at the South Pole. These are the adventurous stories that established the reputation of the young emerging nation that Norway was a century ago. Next to it is the Kon-Tiki museum which exhibits all the memorabilia of the journeys of Thor Heyerdahl, who showed that it was possible to cross the Atlantic Ocean or to reach the Polynesian islands with quite primitive vessels, taking advantage of the right currents; a respectable urge to deliver proof of principle although not always firm evidence that cultural exchange has occurred only along the explored pathways.

On our way from Oslo to the Gardermoen airport we visited the Institute Energy Technology at Kjeller, which, as commemorated in various places on the site, was founded in the 1950's with help from the Netherlands. After an introduction by Mona Lunde Ramstad, Bjørg Andresen told us about the now commercialized system for H₂ production with concomitant CO₂ capture. Erik Foss talked about the photovoltaics programme, and our host Stefano Deledda then introduced us to materials for hydrogen storage. We then visited the neutron reactor and its diffraction stations, and the clean room. And then it was time to retrieve our luggage from the lockers of Lillestrøm railway station, and fly back to the Netherlands ...

Our study tour of Scandinavia (Sweden, Norway) has brought us a large diversity of interesting scientific, cultural, and social experiences. Sweden has a longstanding tradition in science which goes

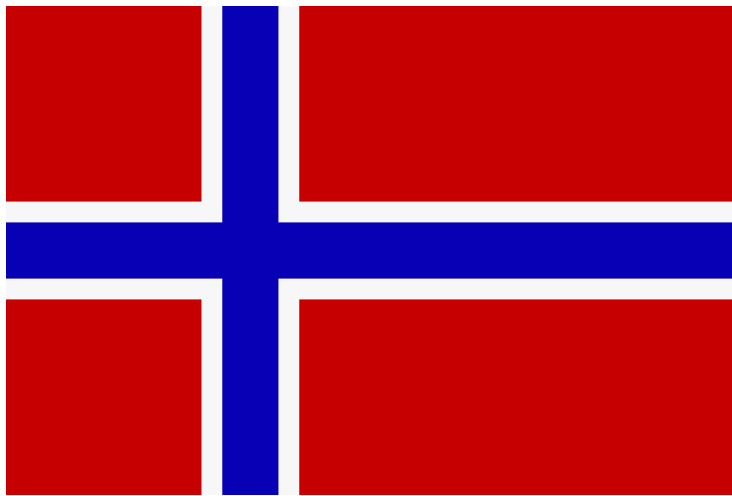
back at least 3 centuries, and it was already a good place to do part of your PhD research 30 years ago; it still combines fundamental academic research with advanced technology, resulting in world-leading companies. Norway has a good climate for spin-off and start-up companies in the life sciences, and invests its relative riches wisely in advanced personalized medicine as well as sustainable energy. Both countries are open to researchers who want to take advantage of their advanced scientific infrastructure and research opportunities for shorter or longer periods. We were made to feel welcome everywhere we came, and I have already heard of some students that want to apply for an internship. I really have to pay the students, in particular the organizing committee, a compliment for the preparation and running of this tour, and I strongly feel that they can congratulate themselves on possibly the most scientifically interesting study tour ever.

PRE STUDY

Part of the 4 EC that the participants of the study tour receive is earned before the tour itself. They are part of the preparation, which include e.g. the symposium and a pre study. Due to the overwhelming number of case studies (see next chapter), only one participant performed a pre study. This pre study, about bioscience in Norway, focuses on research funding in Norway, as suggested by Roland Brock. In this he had a visionary view, since this was a very relevant topic that was broached more than once during our stay both in Norway as well as in Sweden.

BIOSCIENCE IN NORWAY

Jan Nabers



Content:

| | |
|---|----|
| Introduction..... | 14 |
| Background information about Norway | 14 |
| Position of Biotechnology in Norway | 15 |
| Oslo as Center for Biotechnology..... | 15 |
| Cancer research in focus of the Norwegian Research..... | 16 |
| Industrial Biotechnology and active compounds from the sea..... | 17 |
| The landscape of Research in Norway | 17 |
| Human biobanks and health data | 18 |
| The Future of the Biotechnology development Program FUGE..... | 19 |
| NSC: Support of the Norwegian cancer Research | 19 |
| Political and judicial frame conditions | 20 |
| Skeptical perspective on GMO | 20 |
| Public acceptance is increasing | 20 |
| Future perspectives of the Bioscience in Norway | 21 |
| References:..... | 21 |

Introduction

A long time Biotechnology was playing no decisive role in Norway which was rich of natural resources. Since the end of the 1990's the government of Norway is boosting companies in the field of Biotechnology to build up a new branch of economic activity.

Now this development programs showing a positive effect: Especially within the medical Biotechnology and Life Science branch a lot of new companies were built up, most of them were participated in cancer research. Nowadays Norway has more drugs in the research-trials then Sweden, the previous Scandinavian prior in research. Also the research filed of Biorefinery plays a important role in the new Norway industry. [1]

Background information about Norway



Norway is a Scandinavian country which is part of the European Union. Officially Norway is called the Kingdom of Norway because it has a constitutional monarchy as form of government. King Harald V is head of the country while Jens Stoltenberg is as prime minister of Norway the political leader. Norway is a unitary parliamentary democracy with administrative supervisions on county and municipality levels.[4] Norway's territory is the western part of the Scandinavian peninsula, Jan Mayen and the Arctic archipelago of Svalbard and Bouvet Island. The capital and largest City of Norway is Oslo with a population of around 600.000. The area of Norway is about 385,252 square kilometers with a population of 5 million people.

Norway is bordered by Sweden (1619km) in the east and by Finland (727km) and Russia (196) in the northeast. Norway's economy zone within the north sea is verged to Denmark in the south and Scotland in the west. [5]

Although Norway is part of the European Union, Norway is not participated in the European fiscal union Euro. The national currency of Norway is Norwegian Krone (NOK).

Norway is one of the biggest facilitators of the United Nations in terms of money and also takes part in international military missions of the UN forces.

Norway was one of the founding members of the United Nations, the European and the Nordic council and the North Atlantic Treaty

Organization NATO. Furthermore Norway is participated in the World Trade Organization (WTO), the Organization for Economic Co-operation and Development (OECD), the European Economic Area and is part of the Schengen Agreement. [2]

Norway has a lot of natural resources which were responsible for a lot of industrial Power.

The government is controlling the petroleum and natural gas sector. Norway is the world's biggest producer of oil outside of the Middle East and Oil is the most important source of income. 30% of all Norwegian exports are related to petroleum and the petroleum industry is responsible for around a quarter of the country's gross domestic product. The Fish industry is also a significantly branch on international scale because of the highly diverse sea life.

Hydropower great forests and minerals were also important natural resources used by Norway and has a important industrial concern. [2]

Norway was able to develop as one of the world's richest countries by extensive industrialization and the great capacity of hydroelectric power. Because of the close proximity to important export

markets in Europe it was able to develop quickly and especially push the petrol industry. Since a lot of years the Norway government budget is in the surplus.

In anticipation of a shrinking of the petrol sector through the following decades the Norway government is saving petrol revenues and making investments in other profitable industrial branches and is pushing the development of a Biotech industry.

Norway is running a Nordic welfare model with universal health care, a comprehensive social system and a higher education subsidized by the government. In the period from 2001 to 2006 and from 2009 to 2011, Norway scored the highest ranking within the human development ranking in the World. [3][6][7][8]

Position of Biotechnology in Norway

The Biotechnology and Life science branch in Norway is still in an early phase of development. End 1990 the Norway government were starting to boost companies of biotechnology to build up a new branch of economic activity. In Line with the European statistical ascertainment counted the Norwegian government agency “Research Council of Norway” (Forskningradet) in 2007 90 companies participating biotechnologies.[1] Until now a few more companies were built up. The inter-trade organization Norwegian Bioindustry Association (NBA) has around 100 Biotech companies as members. The most of them were very juvenescent. Nearly all of these companies were founded after 2000 and have less than 50 employees. In relation to the small population of 5 million people in Norway, the biotech and life science branch is within the European and north American average.[1][9]



As developing organization for research and development in companies, the SINTEF- group is from mayor importance. SINTEF is the shortening from The Foundation for Scientific and Industrial Research at the Norwegian Institute for Technology (NTH) and is known as the biggest independent Research organization in Scandinavia. Each Year the SINTEF is supporting the progression of 2000 Norwegian and foreign business establishments by Research and developing activities. They are supporting Activities within the healthcare as well as activities dealing with the usage of renewable resources.[1][10]

Oslo as Center for Biotechnology

Geographically the Biotech branch is mainly located in the south of the country, centralized around the capital Oslo. Economic center gravity is located in the county of Nordland, which is stretched along the coast in the northwest of Norway. The companies located in this area were mostly engaged in projects dealing with the processing of substances of content out of the sea. Most of the Biotech and life science companies in Norway were concerned with the development of new therapeutic and diagnostic drugs. [1]

According to the NBA were in the period between 2007 and 2010 in total 22 companies running clinical trials for the approval of new drugs. 14 of these Companies have in proceed 72 Projects running in clinical trials (December 2010). From these drugs 24 were run in phase 3 clinical trials. Total were in all preclinical studies and clinical trials 88 active compounds tested. 60 % of this were developed in own Research or in cooperation with public research establishments. The number of public-private partnerships was raised during this Research period significantly.[11] The NBA is looking positive on the values. With its clinical pipelines Norway were reaching the position of

Sweden, which was earlier the prior country of bioscience of Scandinavia. The bigger part of the active compounds developed by Norwegian companies which were in clinical pipelines were small chemical compounds (70%), the fraction of biological compounds is respective low. Furthermore the most clinical trials were performed in foreign countries. The reasons for this fact can be found in lacking of professional expertise in Norway and insufficient financial incentives for Hospitals and Patients to participate on clinical studies.[1][2][3][5]

The focal point of the Norwegian Biotechnology in Medical science was also shown by the eight companies listed on the stock exchange. All of them were dealing with the topic of healthcare: Photocure (Oslo), PCI Biotech (Oslo), Algeta (Oslo), Clavis Pharma (Oslo), Biotec Pharmacon (Tromsø), DiaGenic (Oslo), Navamedic (Lysaker), NorDiag (Oslo). Furthermore there is also a stock exchange listed Norwegian-Danish company Affitech (Oslo / Kopenhagen)[1]

Cancer research in focus of the Norwegian Research

In the meantime the first Norwegian pharmaceutical entered the Market. In 2009 the therapeutic Cysview developed by Photocure got accepted from the American Food and Drug Administration (FDA). The name Cysview stands for the contrast-diagnostic Hexvix, which is specific for the detection of bladder cancer. In 2009 Photocure was selling the rights for this compound to the French Pharmaceutical company Galderma. Photocure is one of several Norwegian Biotech companies which were located around the Norwegian Radium Hospital in Oslo and working on the topic of cancer research. Already in 2000 the company PCI Biotech was split up from Photocure. PCI Biotech developed a photochemical method to treat different species of cancer, as cerebral tumor, Head and Neck cancer and bladder cancer. Also the company Algeta has a anti cancer drug fast forward in a clinical trial. This anti cancer pharmaceutical is also known as Alphradin and is based on Radium223. The drug should be used in patients with malignant bone metastases to elongate the life expectancy by releasing small doses of alpha radiation to the tumor cells. The compound was developed by Algeta, but for the improvement of the drug and the clinical trials it is cooperating with the German Pharmaceutical Company Bayer Shering since 2009.[1][11]

Also the company Clavis Pharma is working in the field of cancer therapeutics. They were Developing specific drug delivery technologies for pharmaceutical used within chemotherapy. The active compound Elacytarabine produced by Clavis Pharma is in clinical trials and should be potent to treat end stage Acute myeloid leukaemia. Furthermore is another compound active in treating pancreatic cancer, which were disposed to the US company clovis oncology, running in the second stage of clinical trials.

In Tromsø is the company Biotec Pharmacon established. They were on one hand developing immune modulating agents which should be used as therapeutics of Immunological diseases. On the other hand, the company works on cold resistance enzymes, isolated from marine animals.

Within the Diagnostic area is the company DiaGenic known. They were developing gene tests, to screen for diverse diseases in a early stag by using blood samples. In 2009 were BCtect as a test for breast cancer and ADtect as a detection kit for the Alzheimer disease improved for the use in Europe. [1][11]

Furthermore in Norway are a lot of international companies listed on the stock exchange. Most of them were emerge from Norwegian Biotechnology adventures which were fused and adopt by external companies. An example for these originally Norwegian big enterprises were the in Oslo established British-Norwegian company Axis-Shield, arose from the fusion of the Norwegian Axis Biochemicals and the British company Shield diagnostics. Furthermore has the big American company GE Healthcare established a registered office in Oslo by acquisition of Nycomed Amersham International. The same were happened with Alpharma, one of the traditional companies established in 1903 and big fish of the Norwegian Biotech branch. Alpharma is now a 100% subsidiary company

of the US Company King Pharmaceuticals, which nowadays is also part of the American multinational pharmaceutical corporation Pfizer.

Industrial Biotechnology and active compounds from the sea

Next to the Medical Research there are a lot of companies which were participated in the utilization of renewable resources and industrial Biotechnology. The Research Council of Norway is engaged as a observer on European level at the ERA-NET Industrial Biotechnology. [1]

Especially active in this branch is the international operating chemical company Borregaard with the Head office in Sarpsborg. As a Paper and Cellulose producer established, it is keeping one of the world biggest Biorefinery. Furthermore Borregaard is researching for Biochemicals, which can replace petrol based resources. The company started in 2011 with the constructing of a pilot manufacturing plant for the production of Bioethanol, where fuel should be produced from biomass. This project is sponsored for 40% of the Norwegian government. Beyond this the company is also involved in several EU- projects, which were working with the production and further processing of glucose from Biomass. [3][11]

Also acting in the industrial bioscience is the company Biosentrum with office in Stavanger on the west coast of Norway. They were specialized in Up scaling of biotechnological laboratory processes for the Industrial usage.

Since several years more and more companies were founded which were concerned with the ocean as Resource. This is a matter of course for a country with 22.000 kilometres of coast and a economy based on fishing. Companies as Navamedic, Biotec or Pharmacon were trying to extract active compounds for medical purpose out of the Sea and other companies as Aqua Biotech Technology or FMC Biopolymer were trying to withdraw Enzymes and Biomaterials for industrial applications. Pronova BioPharma and BioMar were participated in the advancement of Aquacultures by optimizing food and nutrition while the companies Alpharma, ScanVacc and AquaGen were working on the field of animal healthcare. [11]

Companies dealing with Biotechnological applications for agriculture were nearly no existing in Norway, because of the very small branch of agriculture. But a raising number of companies were participated in the research for new energetic resources respectively with the transformation of Biomass for energetic purpose. This topic is the main activity of firms like Norsk Biogass and Aker Grenland Industry.

The landscape of Research in Norway

Since the early 1990's there were drastic changes in the Norwegian Research system. Within the Universities and high schools was a broad network for Research and higher education established. With support of the European Economic Area agreement was Norway closely connected to the research collaboration of the European Union. [1][2][3]

The most important organization for research in Norway is the Research Council (Forskningradet). 1993 the council was founded and is directly subordinated to the Ministry of Education and fulfil different functions as consultancy of political questions and as assistance organization of fundamental research and application oriented research of all fields. Furthermore The Research council is the responsible coordinator of research networks. The council is representing Norway as Research establishment on diverse EEA-nets which were mostly dealing with renewable Energy questions. [3]

The Research council is also responsible for the specific encouragement of the Biotechnology since 1997. A strategic plan called “Strategi for Bioteknologi” was created to push the Biotechnology with own developing programs by the Norwegian government. Before biotechnological Research were only supported by general and nationwide research programs.

Next to the Research council also the governmental agency for Innovation in Norway was founded which is responsible for supporting Innovation within small and medium sized companies. The Industrial Development Corporation Norway SIVA (Selskapet for industrivekst) is a Norwegian state enterprise supporting industrial Cluster, Networks, Scienceparks and Excellency centres. They were trying to strengthening Norway’s capacity related to innovation and creativity within the industry.

In Norway six Universities were practicing biotechnological Research. The Universities in Oslo, Bergen, Tromsø and Trondheim were established as traditional Universities doing research. The University for Life science in As and the University Stavanger achieved the state as University in 2005. Furthermore is the University in Spitsbergen focused on polar Bioscience.

During the last years, 21 centres of excellence (SSF) were founded and were standing in a close connection to the Universities. They were responsible for a better international cross linking of Norwegian academic activities as applying different key aspects of activity within the research. [1][4]

Eight of this excellent centre’s are active in the field of Biotechnology. The most of them were located in the capitol Oslo, actually 3 of them were located at the University Medical Centre Rikshospital and one other at the University for Life Science in As in the field of Aquaprotein research. Further centres were established in Trondheim concerned with Neuriscience and another one in Bergen involved in Geobiology and climate research.

Next to this centre’s there also is a Excellence cluster Initiative that is tend to cooperations between science and economy. Till now there were two calls for proposals: 2002 were the Norwegian Cluster program Arena found to demand for oil-spill preparedness in the coastal zone and 2006 the Norwegian Centers of Expertise (NCE) was built up. As reported by the Norwegian Research council Arena supported 22 Cluster initiatives in 2009 while NCE were supporting 12. [1]

One of the best known active NCE’s within the Biotechnology is the Oslo Cancer Cluster (OCC) founded 2006 at the capitals Radium clinical centre where a lot of the Norwegian biotech companies were involved. The focus of this cluster is the development of new Diagnostic tools and therapeutic options for cancer as well as the cross linking with renowned Research facilities from foreign countries and international acting companies. [1]

Another active network of biotechnology is the Aquaculture Cluster focused on aspects of fish breeding and aquacultures that can be found along the coastline of Nordland. The University of Tromsø registered The marine Biobank Marbank, which is collecting DNA and RNA probes of many marine animals and providing them for Research and commercial purpose. [1]

Human biobanks and health data

Norway is sponsoring the progression of so called Biobanks with the primary aim to generate “research based new knowledge aiming at prevention, detection, diagnosis, treatment and survival of somatic and psychiatric diseases” (Research Council of Norway).

Biobanks are facilities which were collecting and storing human biological samples for the usage within the research.

The Biobank project is open to all hypotheses and research questions which were dealing with the healthcare and disease topics. The access is not restricted to special research field or methods, but

the project should concern basically the field of “biomedicine, clinical problems epidemiology and or social challenges related to health” as claimed by the council.

The usage of the human biobank of Norway and national research infrastructure efforts as FUGE for analysis capacity and competences is stimulated by the Research council. [1]

The Future of the Biotechnology development Program FUGE

For the period of 2002 to 2005 the European Statistic Project Biopolis has collected six specific initiatives directed to the Biotechnology which were granted with together 150 million Euro. From this the biomedical research got a lot of benefits. The largest Research developing Program for the Biotechnology was called “Functional Genomic Program”(Funksjonell Genomforskning FUGE) which were subsidized with one half of the Norwegian provided financial research fund. [1][9]

FUGE was started 2002 and was discontinued till end of the year 2011. The program has a total budgeted from around 200 million EUR and is authorizing ca. 19 Mio EUR for projects within the fundamental research, for medical and maritime biotechnology as well as for ethical and social problems. This fund stands open in the same way for both companies and public research facilities.

Since 2012 FUGE is continued by a program for Life science that's broader in line with the requirements of the recent socially changes called BIOTEK2021. Following the Norwegian Research council should this containing questions of changes in the climate and environmental conditions, new healthcare aspects, diet but also the find solutions for the competition of a ageing society. The promoted Projects should face these problems globally in the future and reflect the worldwide current state of research. The program is oriented on the explanatory notes of the OECD and of the European Union and should made Norway capable for the international competing. With the broader prospect of the program the focus is more pinpointing to holistic approaches in terms of the development of a Bioeconomy. The Resource council expects that the previous consolidated findings from the Biotechnology can be used to find solutions of problem in the future. With this Strategy for Norway's Biotechnology the Norwegian Ministry of Education is still in the concept phase.[1]

The emerging Bioeconomy should also stronger focus on the further developing of Biorefinery's. The Research council evaluates the agricultural Institutes on this way. With this new program the council is giving advice to a stronger cross linking to the University for Life science in Ås and especially giving obligations to more added value and further developing of the Bioeconomy. [1]

NSC: Support of the Norwegian cancer Research

Essential for the biomedical research is also the Norwegian Cancer Society NCS (Kreftforeningen), a nonprofit organization that supports Lobby work, patient consulting, prevention programs and also research proposals. The NSC is funded by charitable donations and savings of the governmental Lottery company and is giving following the self commitment approximately the half of the budget to the Research. In 2009 20million EUR were permit for research projects (NCS annual report 2009). Following own declarations is the organization finance the most part of the cancer research in Norway from fundamental research to investigations of etiopathology, screenings for new therapies and studies for the frequency of occurrence of cancer. 2009 was the focus set on the course of cancer therapy's by the aged population. [1]

Furthermore a lot of Research facilities in Norway were represented in the expertise network ScanBalt. ScanBalt is a network built up of players of the Life Science and Biotechnology branch of north Europe.

Political and judicial frame conditions

Till 2008 it was forbidden to purchase or arrange embryonic Stem cell lines. Any kind of Research on Embryos, fertilized ovum or cell lines derived from them, was banned. The 1993 composed and 2003 actualized law for the usage of Biotechnology in the human medicine were further prohibiting the cloning of embryos or other methods for the acquisition of genetic identical individuals and where banning the therapeutically cloning in this way. [1][2]

In February 2004 the law were putting into question by a Television program dealing with the case of a thalassemia diseased child which only chance of survival where seen in a stem cell transplantation through a bone marrow donation of an genetic compatible Donor.

This case where changing the public attitude to the in Norway banned Preimplantation genetic diagnosis (PGD) and leads to admission of a PGD in exceptional cases. Finally the public sympathy were the initiative for a change of the Law for the PGD in 2008. Since then it is allowed, as the agreement of the biological parents is given, to use the remaining Embryos of a in vitro fertilization can be used for research purpose. But it is still forbidden to create Embryos only for the Research. Also the reproductive cloning is banned in Norway.[1][9]

Skeptical perspective on GMO

Still restrictive is the legislation by the usage of genetic modified organisms GMO. Following the Gentechnology legislation from 1994 genetic modified organisms must have a sustainable development and must show a observable benefit for the society. The validation is done by the Norwegian Biotechnology Advisory Board (NBAB) and includes environmental risks and the effect on the Biodiversity in not participated countries, the integrity of species, marked request, capacities for problem solving and not-GMO- alternatives, ethically points especially weaker social groups and general health and environment risks. The last ones were the most common reasons for rejecting GMO's. [9][11]

In October 2004 Norway changed its totally Rejection politic into a 0.9% tolerance of GMO's within the agriculture. This tolerance is only aiming on unintended contamination and imports. Contamination with intend of food are still forbidden. In Norway the cultivation of genetic modified plants will not take place. [11]

Public acceptance is increasing

Analogous to the changing judicative also the public acceptance of the Biotechnology in Norway is growing. Following the Eurobarometer surveys of 2010 were one third of the Norwegian civilians agree in the opinion that the development of genetic modified plants must be go on. Even 17 percent advocate the cloning of farm animals to increase the production. 2005 was the intention of the Norwegians especially in this question totally different: Less than 10% were agreeing with the cloning of farm animals. Generally the Norwegians are with this acceptance rate in the higher third of the European population, the civilians of the other countries have a more sceptical view on the usage of Biotechnology within the food chain.

Also the attitude of the medical usage of biotechnological methods was changed in Norway during the last years. 74% of Norwegians supports the development on embryonic stem cells, which is a very high value compared to the rest of Europe. Furthermore 80% of the Norwegian population would release personal medical data to a Biobank under special conditions. Also here was the public acceptance more sceptical in 2005. According to the Eurobarometer bulletin from 2005 was the extraction of embryonic stem cells for organ transplants just for 6% of the Norwegian population acceptable, in contrast to 11% in Europe. Te usage of

genome manipulating techniques to realize the desire for a child was rigorously rejected by 60% of the Norwegians in 2005. It is to assume that the public attention of individual life stories has changed the acceptance. According to the Eurobarometer of 2010 was Norway passing by Great Brittan, which was known as a very liberal.

Future perspectives of the Bioscience in Norway

The Research Council of Norway is annually giving recommendations into the budged discussion of relevant Ministries. For 2012 the Council proposes a gain of budget of 1.2 billion NOK. In 2012 the Research council plans to fund four priority field of research with 60% of this increase. "Open competitive arenas for basic research and research an innovation in industry" will be a funded with total NOK 240 million. This will be divided into NOK 100million to programs for "User-driven Research-based Innovation (BIA)" and NOK 140 million to independent projects. [1]

Projects within the field of Energy and environmental technology will be founded with extra NOK 200 million. The Research of "Climate change and climate policy, and follow-up to Klima21 strategy" will be sponsored by additional NOK 150 million. Furthermore is the Research Council promoting "Scientific equipment and infrastructure, and implementation of the national strategy for research infrastructure 2008-2017" with NOK 140million more. [1]

With this proposed additional funding of NOK 730 million the Research council will achieve five of the goals of the Government White Paper on Research of meeting global challenges, knowledge based industry in all regions, industrial research in strategic areas, a well functioning research system and high quality research.

The new funding and the expansion of the open competitive field together with the budged promotion for scientific equipment and infrastructure will result in high quality research in Norway, a increasing of the internationalization of the Research and new recruitment of expertise. [1]

Norway is boosting the research fields of renewable energy resources and environment and climate topics to become prior position in the solving of social and environmental problems in the near future and to find alternative solutions for oil. Because of the fast growing Biotech and medical science branch in Norway a lot of experts were needed to realize the perspectives of the Norwegian government. The Research council of Norway is supporting the universities to educate professional scientists but also stimulates international companies to invest into the research in Norway. [1]

References:

- [1] The Research Council of Norway; <http://www.forskningsradet.no/> (Feb 2012)
- [2] "Norway". State.gov. 2011-07-18. <http://www.state.gov/r/pa/ei/bgn/3421.htm>. Retrieved 2011-07-23.
- [3] OECD Reviews of Innovation Policy: Norway
- [4] The CIA World Factbook (Feb 2012)
- [5] "Eurostat", the European Union Statistical office
- [6] Human Development Report. hdr.undp.org. 2008-12-18
- [7] Human Development Report. hdr.undp.org. 2009-10-05
- [8] "Human Development Report 2011". United Nations.
- [9] Science and Technology Indicators for Norway 2009
- [10] www.sintef.no (Feb 2012)
- [11]Federal Ministry of Education and Research Germany (Jan 2012)

RETRO PERSPECTIVE VIEW: BIOSCIENCE IN NORWAY

As we have seen during our study tour, Norway is an excellent place for research. Norwegian universities and institutes are focused on different research topics and were practicing beneficial research. During the study tour we visited the Tumor Biology department of the university of Oslo. It was remarkable that the mentioned institute was equipped with state-of-the-art technology, which enabled to answer advanced research questions. The department of Tumor Biology is certified by the Service Provider Illumina SCPro, a company famous for its excellent Genome sequencing technology. The mentioned institute is participating in European as well as in worldwide research projects which requires qualified researchers and state-of-the-art equipment. It was clearly visible that the University of Oslo is promoting qualitative research in order to answer important questions within the Life Sciences. It was quite impressive to see this kind of state-of-the-art laboratory and it is very likely that the department of Tumor Biology of the Oslo University will help to bring forward cancer research.

By visiting the drug companies Lytix Biopharma and Life Technologies (formerly Invitrogen) we could gain an insight into life science companies in Norway. Life Technologies has developed several techniques based on magnetic beads for purification of biomolecules. These techniques are big advantages for life science companies and research facilities because of quicker and better purification. Life Technologies will maintain the established magnetic bead research and production in Norway because of the good scientific infrastructure of Norway.

We also visited the Institute of Energy Technology, which is running a nuclear test reactor for research questions. This reactor (seen in the picture) was co-founded by the Netherlands in 1951. They were analyzing samples with an importance for solar cells. With these high tech analyzing tools they were able to improve techniques to produce solar cells and to upgrade the efficiency of solar cells. The Institute also deals with hydrogen production by solar energy. Another very important topic dealt with in the Institute is the hydrogen storage mostly based on binding to metals. This Institute is closely connected to the industry and is also in collaboration with the famous European research facility CERN.



Solar energy is one of the most important fields of renewable energy technologies. But for Norway solar energy will not be an efficient technology for energy production. The reason is the short period of daylight during winter, which will not be enough for sufficient production of energy. The Institute focuses on global energy questions and solutions. This shows the Norwegian interests in global research and not just in national solutions dealing with energy questions.

During our visit in Norway we gained a depth insight into Norwegian research. We saw that it has a remarkable position in Europe and also in the world.

It seems that Norway is using its position as oil and gas exporter in order to promote research by several fundings to build up a stronger knowledge-based economic sector.

CASE STUDIES

As a contribution to the study tour, participants could also carry out a case study. By doing so, they earned also money, which is paid to the committee by the principal. This way, case studies are a valuable source of income to the study tour committee, which in the end relieves the costs for the participants.

The case studies are usually offered by different departments from our University, but this year it also included one company and the educational bureau. An all-time record of 16 case studies was achieved, which very significantly contributed to the total income.

Here, you will find an overview of the different case studies that were carried out by the participants. As can be seen, they are very diverse. Some are truly scientific, some consists of more ordinary tasks and some are related to our destination.

CASE STUDY – DEPARTMENT OF SUPRAMOLECULAR CHEMISTRY NANOVESICLES

Marlojein Baar & Tjeerd van Dijk

It has been proven that nanovesicles could be very useful in the future. For example, they have great potential in delivering drugs to specific areas in the body. This application is not yet realistic, but vesicles are already designed that can move at relatively large speed and some can even move towards higher concentration of fuels. If the mechanism is known by which these nanomotors move towards a higher concentration of certain molecules, this information could be used to design vesicles that can move in the human body towards target molecules.

In summary, several things are needed to make a nanomotor move in a specific direction. Important is asymmetry in the design of the motor and in the interactions of different materials of the motor with the surrounding fluid. The asymmetry creates a concentration gradient of fuel and reaction products, causing the nanomotor to move due to diffusion. Different interactions with the surrounding fluid will cause the motor to move due to active diffusion caused by an electron gradient. Also bubble formation makes a nanomotor move in one direction with a relatively high speed. This speed is highly dependent on the concentration of fuel. Random movement in a gradient of fuel will result in net movement towards the higher concentration of fuel, because the speed of the nanomotor in higher concentrations is much larger than in lower fuel concentration. Movement based upon a biocatalyst can be provided by means of a rod shape, driven by an ATPase. For directed movement of vesicles, Kinesin-like proteins should be built into the hydrophobic membrane layer.

CASE STUDY – SYN AFFIX BV CLICKING ON THE WEB

Sjoerd Postma

Since its introduction in 2001 by Barry Sharpless, the philosophy of click chemistry really has grasped the (bio)chemical community. Many approaches now exist to perform highly orthogonal, rapid, high-yielding reactions with applications ranging from *in vivo* protein labelling to rotaxane synthesis and nanotube modifications. Two different methods can be distinguished. The first one uses copper(I) to catalyse the reaction between an azide (N_3) moiety and an end-alkyne, the so-called CuAAC

(Copper(I)-catalysed Alkyne-Azide Cycloaddition). However, copper(I) is cytotoxic and even though ligands can be used to complexate copper, a different approach is desired for studies in a cellular environment. Fortunately, strain-promoted cycloadditions provide an excellent tool to safely label biomolecules *in cellulo*. Floris van Delft and his colleagues of the Radboud University Nijmegen are amongst the most eminent researchers globally in the latter field.

To make this overwhelming amount of information easily available for (bio)chemists, Floris van Delft came up with the idea to launch a website. In this way, click chemistry would be only one click away. It was my task to dig into literature and find the most important procedures. Furthermore, the many applications of click chemistry had to be described and clarified with the aid of graphics.

At this time of writing, the work has not yet been completely finished. Obviously, the vast amount of literature on click chemistry is difficult to plough through, and fifty hours are not enough to give a full overview. Nevertheless, with a bit more effort an accessible website will soon be online. It will really be worth it to take a look, since click chemistry completely changed the face of (bio)chemistry. So, please skip your football practice or violin rehearsals, and enrich yourself with chemical knowledge!¹

CASE STUDY – DEPARTMENT OF MOLECULAR MATERIALS

CHARGE SEPARATED STATES

Daniël Schoenmakers & Colet te Grotenhuis

In solar cells, LED's, Field-Effect Transistors and semi-conducting materials, charge reparation plays an important role. The process works as follows: By absorption of a photon, a molecule enters its excited state. Then, the excited electron can be transferred to the LUMO of another molecule (an acceptor), which is lower in energy than the current excited state. This has one positively charged and one negatively charged molecule or part of a molecule as a result. These charges can of course recombine. However, the trick is to postpone that recombination moment as long as possible. This can for example be done by separating the charges further. When they are transported towards different ends of a material, work can be done, just like when you attach a battery to any device.

Currently, a lot of research is done towards organic electronics. In these systems, organic molecules with the capability of absorbing energy (light) and storing it are used. However, it is still difficult to maintain a charge separated state for a long time, while nature does this without any problem. Many processes compete with this, like luminescence and non-radiative decay. Those processes quench the excited state, while that state is very important in developing those electronic devices.

In nature, charge separation has a very important function; without this, photosynthesis would not be possible. Many attempts on recreating the photosynthetic system have been carried out, as well by using derivatives of natural products as by using newly synthesized non-natural compounds. To make this possible, a good understanding of the charge separation theory is of course necessary. In 1956, Rudolph Marcus developed a theory which is now referred to as the Marcus Theory, with which the reaction constant of the electron transfer reaction can be calculated. In his first papers, Marcus postulated a counter-intuitive prediction: The electron transfer reaction has an optimum speed at some value of ΔG° . This means that if the Gibbs free energy is increased more after that point, the reaction speed goes down. This theory has been confirmed experimentally, and can be conventionally used in mimicking natural photosynthesis.

¹ *High grades in Advanced Organic Chemistry are not guaranteed.*

By developing this theory, Marcus gave rise a new research area in which the charge separated states could be better understood and, far more interesting, influenced. Many articles about molecules with long-lasting excited states have been published, as well as ways to influence those states. Many times, large aromatic molecules like buckyballs (C₆₀) and single walled carbon nanotubes are used in order to stabilize and move the negative charge away from the hole, thus postponing the charge recombination moment.

CASE STUDY - ONDERWIJSINSTITUUT MOLECULAIRE WETENSCHAPPEN

Ruben Tent

In the period before the study tour I have assisted the educational bureau as a casestudy. Commissioned by Floris Rutjes, the educational director together with Robert Harmel I have inventorised the hours spent by PhD students on educational tasks.

In the future a department's funding will be based on the amount of education it gives. Nowadays this is a fixed amount. Every department keeps its own administration and this was to be centralized. We spent our time emailing, walking and talking in the different departments within our faculty. In the end we could present our data to Floris Rutjes, who was satisfied with our work.

CASE STUDY - ONDERWIJSINSTITUUT MOLECULAIRE WETENSCHAPPEN

Robert Harmel

In the case study I was busy with administrative work in order to get money for the study tour. I assisted with the administration of the educational program of Molecular Sciences. In the first part of my work I collected data about all of the educational work that is done by graduate students during the year of 2010/2011. This had to be done for all graduate students that have assisted with any educational work and to be collected in a new system set up by the university recently.

The second part of my work was the renewal of the database that collects all features of courses given by the program of Molecular Sciences. I had to update the whole database with new information about all changes that happened in the last 6 years and I had to make filters that were needed to collect certain information from the database. These pieces of information were later needed for the critical self-reflection on the bachelor and master courses that are given in the program of Molecular Sciences.

CASE STUDY – DEPARTMENT OF ANALYTICAL CHEMISTRY CHEMICAL ANALYSIS

Roy Awater

Provided by: Tom Bloemberg

This case study was provided by Tom Bloemberg from the department of analytical chemistry. Part of the first year course "chemical analysis" is the evaluation of IR, NMR and MS spectra with ISPEC4. ISPEC4 is an outdated (MS DOS based) computer program. The goal of this project was to transform

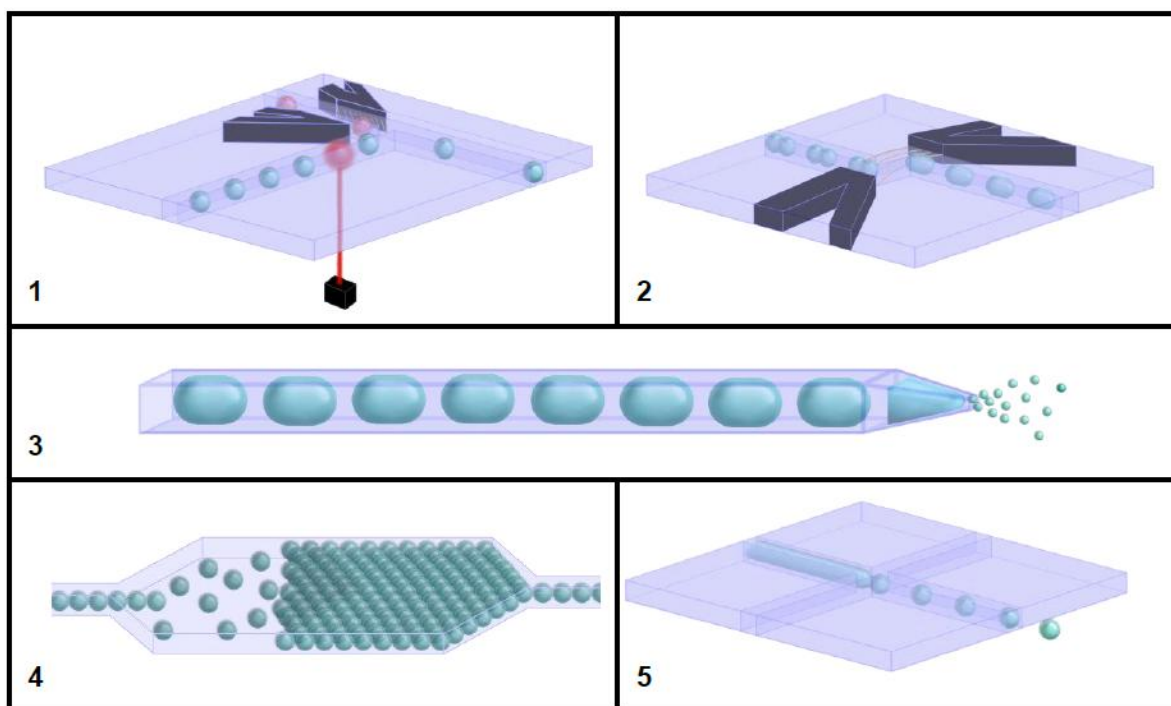
the ISPEC program into assignments for the students. Spectra from the ISPEC program were transported to a word file and questions for the students were added. Based on these assignments a new program can be created by an IT-company.

CASE STUDY – DEPARTMENT OF PHYSICAL ORGANIC CHEMISTRY
3D-DRAWINGS OF MICROFLUIDIC SYSTEMS

Samantha van der Beek

The group of prof. Huck uses microfluidic systems to control reactions at a picoliter level. These silicon-based devices are usually composed of different compartments to study and control the kinetics of a reaction. I made 3D drawings of five different functional compartments:

1. Sorting. When the droplets reach the T-junction only the droplets excited by a laser are drawn towards an electric field.
2. Fusion. Two droplets in close proximity can be fused together when passing an electric field.
3. Spraying. Mass spectrometry is often used to analyse the reaction product. A microfluidic system can be coupled to a mass spectrometer where the droplets must be sprayed and ionized for further analysis.
4. The bottleneck effect. A chamber will slow down the droplets causing them to accumulate at the next smaller opening.
5. Droplet formation. A continuous flow of water is interrupted by two flows of oil at the 4-way junction creating water droplets in oil.



CASE STUDY – DEPARTMENT OF BIOORGANIC CHEMISTRY
BIOSENSORS IN CLINICAL ANALYSIS OF TEAR FLUID

Clara van Emmerik

Biosensors can be used to determine metabolites in body fluids in a way that has multiple advantages over conventional methods for diagnostic analysis. They are very specific for the target analyte, simple to use and give quick results. One of the current objectives is to develop amperometric biosensors that can enzymatically measure metabolites in tear fluid. These non-invasive tear biosensors could be very useful devices in diagnostics and monitoring of diabetes, renal disease and other metabolic disorders.

There are many metabolites present in tear fluid that could be interesting targets for biosensor research, such as lactate, pyruvate and creatinine but also alanine, urea and others. More systematic research is needed to identify all compounds and their normal concentration range in tear fluid. Furthermore, elucidation of the transport mechanisms of the blood tear barrier and more insight into the production of tear fluid by the different lacrimal glands could help in predicting which metabolites will have a good correlation with their blood values. By investigating the differences in tear analyte levels between patients and healthy individuals, new biomarkers might be found that can be measured quick and non-invasively by tear biosensors.

CASE STUDY – DEPARTMENT OF BIOORGANIC CHEMISTRY
BIOSENSORS IN CLINICAL ANALYSIS OF TEAR FLUID

Krista Polman

Diabetes Mellites is a chronic disease characterized by the body's inability to produce or properly use insulin. This is a hormone needed to convert sugar, starches and other food into energy. Without proper management of the disease, diabetes can lead to severe long term health complications. Monitoring of blood glucose is important for managing the disease. Frequent measurement of blood glucose level can help to prevent hypoglycemia and hyperglycemia and is of great importance for diabetics and their quality of live.

The current method of blood glucose monitoring at home is by use of a glucometer. The patient takes a small blood sample from a fingertip and applies it to the test strip of the glucometer to analyse it. Ideally, this should be done several times a day, but this method is quite invasive due to the painful finger pricks and therefore many people do not test regularly. Non-invasive methods are the solution for this problem, as it would allow patients of diabetes to test their blood as often as necessary without painful consequences.

There has been extensive research in recent years on alternate means of glucose measurement, with an emphasis on analysis of other body fluids to find such a non-invasive method. This study focusses on the non-invasive monitoring of glucose concentration in tear fluid. It addresses the correlation between blood glucose and tear fluid glucose levels and several methods of measuring the glucose concentration in tear fluid. The two most promising methods are modified contact lenses and electrochemical biosensors. Both can be adapted for continues self-monitoring of glucose by patients, but still need further research on correlation between blood and tear glucose, accuracy of measurement and biocompatibility.

**CASE STUDY – DEPARTMENT OF BIOCHEMISTRY
COUNTING CELLS**

Edo Luijten

My case study exists of practical work for Roland Brock, at the department of Biochemistry. I'm helping Nils Rother with his research, who is doing his internship at the department. In his research he has treated erythrocytes with several compounds that effect the phosphorylation of certain membrane proteins. This also influences changes in erythrocyte morphology. During the treatment, microscopy photos were taken at certain time points, after which you can count the number of cells with a certain morphology. You can then compare between time points, as well as between different compounds.

In order to get a more reliable counting, this has to be done in duplicate. Therefore they asked me to also count the cells in these microscopy pictures.

**CASE STUDY - DEPARTMENT OF ANALYTICAL CHEMISTRY
FROM R TO MATLAB**

Karen Berntsen

I executed a case study for the department of Analytical Chemistry. Some people from this department use the programming language R. Various clustering and classification methods are programmed in this language. In one of the subjects that the department teaches, Pattern Recognition in Natural Sciences, these scripts are used. Because most of the students and department members are familiar with Matlab and not with R, the department would like to have the functions (and the exercises that come with them) translated. I used some algorithms that the department had translated earlier to change the exercises, and I translated the mixture modelling algorithm from R to Matlab.

**CASE STUDY - DEPARTMENT OF SOLID STATE NMR
FACILITY WEBSITE**

Lena Ebert

This case study was offered by the department of Solid State NMR. The idea was to set up a new facility website for the department. The website should present information about using the NMR apparatus for people outside of the Radboud University Nijmegen.

The university uses the Content Management System (CMS) of RadboudNet to build and maintain websites without any special programming skills.

The first step within the case study was to gather all information aspects which should be presented on the website. Included were information on the procedure to book measuring time, on the equipment, the department and the people working there.

Those general aspects were arranged in a clear structure to achieve a user-friendly website. Based on this structure the website was built. To implement the website it was completed with texts, pictures,

links and a downloading area with all required forms. The website is self-contained but also embedded in the department's website.

CASE STUDY - DEPARTMENT OF BIOPHYSICAL CHEMISTRY

PARAHYDROGEN INDUCED HYPERPOLARIZATION

Esther van der Heijden

This case study was received from the department of biophysical chemistry. The goal of this case study was to get an overview of the literature on recent developments in research on parahydrogen induced hyperpolarization. This case study is related to the UltraSense NMR project, which is an consortium between the Institute of Molecules and Materials (Radboud University Nijmegen), Radboud University Nijmegen Medical Centre, University of Twente and three companies (Future Chemistry, Spinnovation Analytical and NovioGendix).

Magnetic resonance is a principle that is widely used in medicine and chemistry. In medicine magnetic resonance is used in magnetic resonance imaging, a medical tool for diagnosing patients. Also magnetic resonance is used in magnetic resonance spectroscopy, which gives biochemical information about living tissue and which is used in metabolism studies. In chemistry nuclear magnetic resonance is used to determine the structure of compounds and to look at conformations of atoms. NMR is a powerful technique, but NMR is limited by its low sensitivity. The sensitivity of NMR and MRI is low because the detected signal strength depends on a small population difference between spin states.

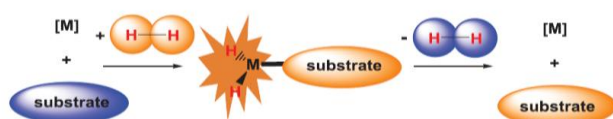


Fig. 1. Schematic representation of the magnetization transfer process.

[1]

Hyperpolarization methods are used to alter the nuclear spin population with respect to the thermal equilibrium of nuclear spins (Boltzmann distribution) and thereby increasing the population difference between spin states. The signal intensity of NMR is proportional to the spin population difference, therefore hyperpolarization methods can lead to an increase of NMR signal strength as high as 10^5 . Dynamic nuclear polarization (DNP) is a hyperpolarization method where the nuclei are polarized at low temperature (circa 1K) and high magnetic field (circa 3T) for several hours. The compound is subsequently defrosted and dissolved to yield a room temperature solution containing hyperpolarized nuclei. Para-hydrogen induced polarization (PHIP) is a method which uses a hydrogenation reaction to transfer hyperpolarized protons onto the molecules. This is quite an easy process, but a requirement for PHIP is the use of hydrogenatable molecules and after hyperpolarization the hydrogenation catalysts must be removed from the sample. NMR signal amplification by reversible exchange (NMR-SABRE) is a hyperpolarization method where a metal complex facilitates a reversible interaction of para-hydrogen with organic molecules (fig 1). This way high-resolution NMR spectra can be detected.

1. R. W. Adams *et al.*, *Science* **323**, 1708 (2009).

**CASE STUDY - DEPARTMENT OF BIOINFORMATICS
BIOINFORMATICS IN SWEDEN**

Yvonne Sijssens

The main goal of the bioinformatics case study was to create an overview of the bioinformatics studies in Sweden. Sweden has 35 universities, of which 15 offer natural studies. These were the universities I took a closer look at to find out if, and what type, of bioinformatics was being taught there.

Of these universities, only eight actually have a bioinformatics department, and only three offer a full bioinformatics master. Two-thirds of the Natural Sciences universities do offer some kind of bioinformatics course. Bioinformatics is mostly grouped under Biology, though Umeå has the department listed as a subgroup of Mathematics and Mathematical Statistics.

During our visit to Uppsala's Bioinformatics department on our first day in Sweden, Professor Eric Bongcam-Rudloff provided some more insight into the history of bioinformatics in Sweden. He explained that there used to be more bioinformatics studies in Sweden, and even some bioinformatics bachelors, but many were closed down around 2009. Now that bioinformatics is becoming a hot issue again, he expects more universities to start bioinformatics groups. As it is now, the master and PhD-students come from many different studies, including biological, medical and informatics studies.

PROGRAM

The study tour consisted of two full weeks of organized visits, cultural excursions and free time.

A schedule of all these activities is given below. In the next chapter a detailed account of every day can be found.

| Date | Time | Activity |
|-------------|-------------|---|
| Mon 23/04 | 03:30 | Travel by bus to Schiphol |
| | 06:50-08:50 | Flight from Schiphol to Stockholm Arlanda Airport |
| | | Travel by train to Uppsala |
| | Followed by | Walk in Uppsala centre |
| Tue 24/04 | 08:30-12:00 | Visit GE Healthcare |
| | 14:00-17:00 | Visit Bioinformatics, Swedish University of Agricultural Sciences |
| Wed 25/04 | 09:15-12:00 | Visit Photosynthesis Group, Uppsala University |
| | | Lunchtime / Walk to Gustavianum |
| | 13:00-14:00 | Visit Gustavianum |
| | 16:39-17:19 | Travel by train to Stockholm |
| Thu 26/04 | 09:00-12:30 | Visit Department of Medical Biochemistry and Biophysics, Karolinska Institute |
| | 13:30-17:00 | Department of Neurochemistry, Stockholm University |
| Fri 27/04 | 09:00-11:30 | Visit Sandvik |
| | 14:00-15:00 | Visit Vasa ship museum (tour by conservator) |
| | Evening | Dinner party with science association NF |
| Sat 28/04 | | Time off / Pub-crawl |
| Sun 29/04 | 12:00-13:15 | Boat from Stromkrajen, Stockholm to Vaxholm |
| | Of choice | Sightseeing in Vaxholm |

Study Tour 2012 – Norway and Sweden

| | | |
|---------------------------|-------------|---|
| Mon 30/04 | 10:00-15:15 | Visit Organic Chemistry, Stockholm University |
| | 13:30 | Visit Skansen and afterwards Walpurgis Night |
| Tue 01/05 Workers' Day | 11:00-12:00 | Visit Nobel Museum |
| | Followed by | Time off |
| Wed 02/05 | 08:25-14:21 | Travel by train to Oslo |
| Thu 03/05 | 09:00-12:00 | Visit Lytix Biopharma |
| | 14:00-17:20 | Visit Life Technologies/Invitrogen Dynal AS |
| Fri 04/05 | 09:00-12:15 | Visit Cell Biology, University of Oslo |
| | 12:55-16:30 | Visit Tumor Biology, Cancer Institute, Academic Hospital Oslo |
| | Evening | Dinner party with Science association Realistforeningen |
| Sat 05/05 | 11:00-14:00 | City tour Oslo |
| | 14:00-15:00 | Lunch and ferry to Bygdøy |
| | 15:30 | Visit Viking museum |
| Sun 06/05 | | Day off |
| Mon 07/05 | 10:00-14:00 | Visit Institute for Energy Technology, Kjeller |
| | 17:20-19:05 | Flight from Oslo Airport, Gardermoen to Schiphol |

DAILY REPORTS

Here you will find an extensive day-to-day description of the study tour in which the participants will shine their lights on both their academic and cultural experiences.

MONDAY APRIL 23RD, NIJMEGEN/UPPSALA

ZOMBIE-INVASION IN UPPSALA

It's three o'clock in the morning. Behind the Huygens building in Nijmegen, a few students with big suitcases are waiting for their bus to arrive. In the meantime, the new black sweaters with a nice orange print are handed out to the Study Trip participants. Then, the bus arrives, with Bart seated next to the driver. How he had arranged that remains a mystery to everyone. After a final check, everyone enters the bus and they're off to a two-week long trip to Scandinavia!

After a one-and-half hour ride, they arrive at Schiphol Airport. After check-in, there is still some time left for tax-free shopping before they are supposed to be at the gate. However, the intercom tells them that the Dutch cockpit-crew was not present in Amsterdam, so the flight will be delayed. So much for the reliability of the KLM personnel... After fifteen minutes, the crew arrived, so we were allowed on board. For many it'll be the first flight, so the stress-level is high for the early hour of the day.

The flight was calm and easy and after two hours, around nine in the morning, the study trip group arrives at Stockholm Arlanda. After check-out and a short train trip, the first destination is reached: Uppsala.



The huge cathedral of this university-city immediately draws the attention of the students. But first they have to place their luggage in a room in the hostel. After doing that, the first and only item on the program of the day is of course visiting the cathedral; or more in general, sight-seeing in the city. After the cathedral visit, the tiredness is visible on everyone's faces. So, a quick city walk is all that's left for the day.



In the evening, everyone is hungry. Because the hostel has a large kitchen, the idea of cooking together is born. Dinner for the entire group, consisting of pasta with tomato sauce, is served. After dinner, no one has energy left to do anything anymore, so after playing some card games everyone goes to bed.

This zombie-invasion in Uppsala was a great start of a wonderful study trip!

Daniël Schoenmakers

TUESDAY APRIL 24TH, UPPSALA

VISIT TO GE HEALTHCARE & BIOINFORMATICS (UNIVERSITY OF UPPSALA)

After sleeping off our jetlag, we went on our way to visit GE Healthcare's Life Science department in Uppsala. This company develops and produces tools and technologies for protein research.



We were very happy to be introduced to the wonderful coffee machine first, which we readily made use of. Then, we got a very kind introduction from a fellow Dutchie called Jos Buijs, who has been working for GE Healthcare in Uppsala already for some time.

Jens Widehammer is a research engineer for GE Healthcare and he told us something about chromatographic purification of proteins. Proteins can be separated based on different properties, such as charge, affinity, tags, hydrophobicity and size/volume. Additionally, the length and width of the column and the size of the beads have an influence on the resolution of your separation. GE Healthcare tries to develop and optimize these beads and the corresponding chromatographic systems for different purposes, for example for proteomics, protein research or protein production.

After another round of coffee, Jos Buijs gave a presentation on Biacore, which is the name of a separate division within GE that develops a new method for confident analysis of interactions between biomolecules. The development of this technique started about 20 years ago, the main aims being to find new drugs and to improve our understanding of biology. The method is based on a microfluidics system, consisting of a soft polymer that can be modified by air pressure to open and close the channels. The sensor's gold surface within this microfluidics system can be functionalized with molecules of interest that are to be tested for interactions. Detection of these interactions is done by Surface Plasma Resonance. Energy from an evanescent wave can be absorbed by the gold particles. The absorption is dependent on the binding of biomolecules to the gold surface. This label free method turns out to be very sensitive. It can not only detect interactions but also measure kinetics and binding affinity.

After these nice talks, we had a guided tour through some of the labs by Jesper and Eva. We had a very extensive and early lunch, which is very common in Sweden. "You're not supposed to eat sandwiches for lunch" as Jos told us.

After a somewhat chaotic bus trip we arrive at the department of Bioinformatics of the University of Uppsala, where we are immediately led away by the enthusiastic Erik Bongcam-Rudloff. It's a little

crowded with twenty-six people in the little conference room, but after finding some extra chairs we settle in to listen to a couple of talks. Erik starts the talks himself with a brief introduction on genome sequencing, its quick progress and the possible answers that knowledge of the genome might bring us. This introduction is followed by talks from Oskar Karlsson (AniBio Threat), a nervous Martin Norling (the only bioinformaticist in the group, who spoke about *Theliera parva*) and a somewhat difficult to understand Shahid Manzoor (Bacterial Genomes Project).

This talk is followed by a very welcome coffee break. Apparently the coffee break is holy in Sweden, something which Erik will not soon forget.



After the break, Thomas Klingstrom holds the final talk about his new company, Modelomics. This company attempts to predict which patients will respond well to medicines. With this kind of information, drugs that are turned down in phase 2 or 3 development can become useful for a smaller part of the patients, even if it did not pass the test for all.

Having thanked Erik and his group for their hospitality, it is time to figure out which buses to take back to the hostel.

Clara van Emmerik & Yvonne Sijssens

WEDNESDAY APRIL 25TH, UPPSALA/STOCKHOLM VISIT TO PHOTOCHEMISTRY & MOLECULAR SCIENCE (UNIVERSITY OF UPPSALA)

After a 6 hour nap in Uppsala we headed to the breakfast at 8.30 in the hall of the hostel. Since it was our last day in Uppsala we stored the bags in the basement of our accommodation and went by bus to the science faculty at Uppsala University. Once we arrived at the Department of



Photochemistry & Molecular Science we met the head of the Photosynthesis group: Prof. Stenbjörn Styring.

After a short introduction and his funny conclusion that he actually knew Martin Feiters even before we were born, he started to talk about the concept of hydrogen fuel production from artificial and biological photosynthesis. He shows us the need of this technology and tries to clear up our minds from the confusing climate reports that were presented in the media over the last couple of years. Prof. Stenbjörn Styring then switched over to renewable energies and tries to place his own idea into the whole energy landscape.

Besides this concept there were two more speakers on the list for the day; Karin Stensjo and Reiner Lomoth. They went into more detail about the biological approach and the artificial approach of hydrogen fuels from photosynthesis.

Karin Stensjo told us how cyanobacteria and green algae can be used to make hydrogen directly from light by the splitting of water. She claimed that all other microorganisms that can do this, need to be fed with carbon food. In her research she focuses on the heterocyst of the cyanobacteria which is basically the center of hydrogen production. The idea is to mutate the heterocyst to maximize the hydrogen production. The mutate cyanobacteria can then be used in bioreactor to produce the fuel.

Reiner Lomoth focused on the chemical photosynthesis. In his research he basically mimics the properties of the cell with a catalyst that should be able to split water into protons and oxygen. The best systems that were reported were derived from ruthenium based compounds. However ruthenium is not abundant enough on earth to solve the energy problem so he decided to look more into iron and manganese derived compounds. In his research he changed the metals but he had no luck with this simple idea because kinetics and thermodynamics made it troublesome. His research team worked further with manganese/ruthenium compounds but the results are not good enough yet to be a solution.

With the lectures finished and after a short meal we headed further to Gustavianum at about 14.00; a museum which used to be part of the university of Uppsala. In the 4th floor there was an exhibition about the Valgårde (Vikings) and beside that there was a big lecture room where some of the first anatomy studies on the human body were made.

Next on the list at about 16.00 was the train trip to Stockholm. After a short walk through the city we arrived at our hostel in the basement of a house. There we occupied with 6 people a room of about 16 m² where it was not possible to open the window. Happy to be not in the room, we finally finished the day in the kitchen by watching the semi-final of the Champions League.

Robert Harmel



THURSDAY APRIL 26TH, STOCKHOLM

VISIT TO KAROLINSKA INSTITUTET & DEPARTMENT OF NEUROCHEMISTRY (STOCKHOLM UNIVERSITY)

Our first morning in Stockholm started with a breakfast which was served at a café in the immediate vicinity of the hostel. Eventually everyone found the café and the group took the very crowded bus to the Karolinska Institute. The bus driver who was behind schedule did not look very happy with our large group. At the department of Medical Biochemistry and Biophysics (MBB) we met Gunther Schneider, head of the division 'Molecular Structural Biology'. He welcomed us with coffee and Swedish pastries before he introduced us to his research about 'Structural enzymology of the biosynthesis of polyketide antibiotics'. The research is focused on anthracyclines which belong to the most-used chemotherapeutic agents in cancer treatment. They want to determine the structural enzymology of the biosynthesis of those antibiotics.



Schneider also presented a second research topic. In the project 'Structural biology of bacterial pathogens' they work on structural and function characterization of proteins from major pathogens like *Pseudomonas aeruginosa* and *Mycobacterium tuberculosis*. The aim is to get enough information to help designing strong binding inhibitors which could lead to new drugs. This research project is part of AEROPATH which is a European multidisciplinary research program for the identification, characterization and exploitation of novel Gram-negative drug targets.

The next talk was given by Esben Quistgard, a PhD student in the group of Pär Nordlund at the biophysics division. This division is focused on the structural basis for the function of proteins involved in disease processes, especially cancer, inflammation and infectious diseases. They are also trying to develop better technologies to solve problems in protein production, crystallization and structure analysis.

Jodie Guy, an assistant professor in the division of Molecular Structural Biology, presented her work on multi protein complexes in the eukaryotic endoplasmic reticulum. Those complexes assist in the folding, modification, sorting and quality-control of newly-synthesised proteins. With a combination of X-ray crystallography and biochemical and biophysical studies they want to get detailed pictures of the protein structures, functions and interactions.

In the last presentation of the morning Helena Berglund gave us an overview over the core facilities of the department. The MBB Protein Science Facility has the aim to provide academic users with protein production services as well as with access to infrastructure for protein crystallography and biophysical protein characterization.

Following the presentations three staff members showed us their work at the laboratory where we got a closer insight of the work at the MBB. We completed the morning at the Karolinska Institute with a nice lunch.

In the afternoon the group went to Stockholm University for a visit to the department of Neurochemistry. There we were welcomed by the head of the group; Prof. Ülo Langel, who was quite a remarkable person to say the least. For our visit, he had organized a mini-symposium of only four speakers. Two speakers were of the department of Neurochemistry (Jonas Eriksson and Kristin Karlsson) and two speakers were of our own group (Dr Martin Feiters and Luc Depré). There was a high variability in the length of the presentations, but this had no influence on the amount of interesting and critical questions, which were asked.

The PhD student Jonas Eriksson started the symposium by a presentation about an antiviral approach with CPP applications, which could possibly be used to develop a medicine for the retrovirus HIV. Eriksson tried to develop a virus, including a Caspase-3 protein which, when it is expressed in the cell, leads to cell death. To avoid healthy cells to die, this protein is attached to another protein and could only be cut off by a protein, produced by HIV. Therefore the caspase-3 would only be active in HIV infected cells.

Dr. Martin Feiters told us something about the delivery of nucleic acids by gemini-like amphiphilic peptides, which could be used for gene therapy for diseases like cystic fibrosis and bladder carcinoma. Since nucleic acids are negatively charged, cationic liposomes were used as trafficking vesicle. After endocytosis of the vesicle, the nucleic acid escapes from the endosome due to the decrease in pH of its environment. The used nucleic acid could for example be siRNA, which can be used for inhibiting a viral protease, that is essential for the virus to split his own polyprotein in structural and non-structural proteins. By inhibiting this protease, the virus is not able to spread itself anymore.

Kristin Karlsson, also a PhD student, talked about her study to GalR ligands. The first discovered galanin was a peptide with an N-terminal glycine and a C-terminal alanine. Homologous proteins in other animals had the same N-terminal part, but included an extra C-terminal part. These galanins have a variety of biological functions.

Luc Depré showed us the role of HS binding in antimicrobial CPPs. Therefore the structure of a specific loop, essential for the binding of the CPPs, was investigated. By mutating two bridged cysteine into serines, it was shown that the loop didn't fold properly and that the protein didn't work anymore. Additionally, also other amino acids in the loop were mutated into alanines to discover their importance. It was shown that some conserved residues like tryptophan had only a few effects on the activity, while a higher amount of positively charged residues increased the uptake of the CPPs by the cell increased.

After the educational program we decided to give the kitchen in the hostel a try. We were really lucky with the kitchen in Uppsala where we could cook for the entire group. In Stockholm there was only one cooking plate and due to the smoke detector only cooking and no frying was allowed. Nevertheless we succeeded in making a pasta salad for a small group.



The following, a search of a bar close to the hostel, was far more difficult. After we walked around quite a time we gave up on finding one and went to the supermarket to buy beer and sat down in the kitchen. Officially it wasn't allowed to drink any alcohol in the hostel. So every time the kitchen door was opened the beer cans were covered. This went well until one can toppled in doing so and Krista's

scarf and some playing cards were drowned in beer. Later that night our supervisors came home in a good temper and slightly drunk from an evening out with Ülo Langel.

Karen Berntsen & Lena Ebert

FRIDAY APRIL 27TH, STOCKHOLM

VISIT TO SANDVIK & VASA MUSEUM

This day we went to Sandvik, a Swedish company founded in 1862. Sandvik is an engineering group that is specialized in tooling, stainless steel alloys, materials technology, mining and construction. We left at 8 am at the metro station and the metro took us out of the city centre to the metro stop 'Telefonplan'. From there we walked to the industrial park where Sandvik was located.

At Sandvik we got an introduction about the company and we got the schedule for that morning. First the introduction, then a visit to the material science laboratory, then a tour at the ceramics production site followed by a tour at the mining production site and afterwards a lunch at the cantina of Sandvik. In the introduction a woman told us that Sandvik consists of five business areas: mining, machining solutions, materials technology, construction and venture. This introduction was at Sandvik machining solutions. Here they do research at tungsten carbide, which is a hard material and cobalt, which is soft and used for binding. A lot of research is done on the composition of this mixture, to find the best material for several areas of application (tooling, mining).

The visit at the material science laboratory was quite interesting. The tour started at a small factory hall, there were testing machines where all kind of parameters could be varied. They also had some equipment for material characterization and a chemical vapour deposition furnace for depositing surface layers. After this visit we got a tour at the production site of Sandvik ceramics, here they produce tools for the metalworking industry. They showed us machines where they melt and mix the materials and make the tools, but also machines that make edges on the tools and other machines that apply surface coatings. After this tour we got another tour at the Sandvik mining production site, where they produce drill bits and components of drill bits. It was interesting to see how many products they produce. You would not expect it to be so much work to produce these drill bits. After these visit we had a lunch at the canteen of Sandvik, which was nice because we got a warm meal and we had the chance to speak with people from Sweden.



After this good lunch at Sandvik, it was time to travel all the way from the Telefonplan station in the south to the island of Djurgården on the other side of Stockholm. This beautiful island holds the huge open-air museum/zoo Skansen, a theme park with some terrifying rollercoasters and a few museums. Our destination for today was the Vasa museum. Built in the 1980's, its purpose was to create a permanent place for the warship Vasa, that had been resurfaced in the early 1960's. Instead of just walking around the ship in amazement and taking pictures, we had a guided tour through the museum by one of the conservators.

She started by telling us the story of why the Swedish king, Gustav II Adolf, ordered the production of the huge warship. It started when the king of Poland, Sigismund III, who had also been king of

Sweden in the 1590's until he was disposed, started a war to reclaim the throne of Sweden. A large part of the Swedish navy perished in this war, thus the building of new ships was ordered.

Vasa was meant to be the head of a strong new naval power in the Baltic sea, to aid the Swedish king in protecting his throne and maybe even claim the Polish throne. No expense was spared in decorating and equipping the Vasa and the king's ambitions could be clearly seen on the stern of Vasa. The top was decorated with two griffins (the coat-of-arms of Sweden) holding a crown above Gustaf's head.



After two years of hard work, the ship was ready for her maiden voyage. But the hull was built too narrow and the ship was top-heavy, so after sailing less than a nautical mile, it foundered and sank in the middle of the Stockholm harbour. The harbour was too shallow for the ship to sink fully under water, so the three masts stuck out from the surface, until they were removed.



When the ship was resurfaced in the early 1960's, it was in surprisingly good condition, but it would have quickly deteriorated if the hull had been simply allowed to dry. After some debate on how to best preserve the ship, conservation was done using polyethylene glycol (PEG). Vasa was sprayed with this glycol for 17 years, followed by 9 years of slow drying. The reason for the good

preservation of the ship under water, was the highly polluted harbour of Stockholm, where hardly any microorganisms could survive. Unfortunately, the toxicity of the water also had a negative effect. The sulphides present in the water had penetrated the wood and the ship was salvaged, it began reacting with oxygen out of the air it was exposed to, creating sulphuric acid. Due to the acid, white spots of sulphate-containing salts began to form on the exterior of the wood. The salts themselves are not a threat to the conservation of the ship, though the discolouring of the wood is unwanted, but when the salts start forming inside the wooden planks, they could cause serious damage to the planking from inside. Enough sulphides are present in the ship, that they might eventually destroy the ship almost entirely. So the challenge is huge, but the conservators at the Vasa ship museum do their best with modern technology to preserve the ship as best they can.

After our guided tour, we had some time to look around for ourselves in the museum, before we headed to the campus of Stockholm for a dinner party with the science association Naturvetenskapliga föreningen (NF). We learnt that when a Swedish dinner party starts at six o'clock, you should not arrive before seven. It was not just having dinner together with some Swedish students and having fun, but it had a certain formality.



Our host was chairman that evening and he explained the traditions around a student dinner party. For example the singing during dinner. A random person would start saying 'ooooo(ooo)ooooh' and everybody joins him or her, and then all together the word 'tempo' is said. If the group succeeds, the chairman decides which song to sing from the NF handbook and the whole groups starts singing. This happened several times during our traditional Swedish dinner consisting of köttbullar, mashed potatoes and sweet lingonberry jam. One time we were asked to sing a (typically Dutch) song. We decided to sing our anthem where Martin accompanied us with piano. After dinner the tables were stored away and it was time for drinking games. A certain committee member even joined a Swedish student in breaking into the lab and stealing some dry ice... All in all a great evening and having the day off the next morning was very much appreciated.

Esther van der Heijden & Krista Polman

SATURDAY APRIL 28TH, STOCKHOLM

DAY OFF

After everyone was somewhat rehabilitated from the night before, the dinner party with student organization NF and the international party afterwards, it was time to get out of bed. This day was free of program, however there was a pub crawl organized for all students in town. Because we were on the right place and the right time, we (Jan, Robert, Tjeerd & myself) were pleased to join this huge event and bought the tickets the night before where we met one of the organizers, a member of NF. When we were ready to go, the search for the locations had started. With our 7-days public transport card this shouldn't have been a problem. A good thing was that we already had a guidebook about what and how the day would proceed, slight issue was that this was completely in Swedish language. Nevertheless we went to the direction of the university and stopped one subway-stop before at Tekniska Högskolan, which had several pub-crawl locations according our map in the guidebook. However these stops opened only around 18:00 and not at 14:00 when we were there. This brought us back to the subway where we headed to the university. We visited a few places here and enjoyed the good weather and Swedish students. From here we heard about special buses travelling between the locations, each having its own theme. In addition these busses were really a must-seen for us. In a coincidence our bus had the theme of love, where we had the change of asking all our questions to the organizers in the bus. During this trip we really enjoyed the questions and the show (language barriers are not such a problem for u) and got some necessary items, such as red-bull. Our bus was heading to Karolinska Institutet, where we had been before in a completely other setting. This time there was a complete party and lots of students enjoying their yearly pub crawl a lot. When the time of dinner arrived we went back the hostel for some food, where we had a very good pizza-baker across the street. After we were energized again, the direction to go was the 'big end party' somewhere at the Högskolan area. Luckily some other students could recognize us in the subway because of their red plastic bracelet, the entrance ticket. They were willing to guide us to the right place and after waiting in a never ending queue, we entered a huge Swedish party consisting of two big music halls and a Wii dance room. This awesome party kept us busy until 03.00 o'clock when everything closes and we had to go back to the hostel for a good sleep.

Ralph Slijkerman

Most of the students wanted a somewhat more relaxing day and used this day off to explore the city centre or some nature. We (Bart, Edo, Clara, Merijn, Inès and myself) wanted to see some of the surroundings of Stockholm. Therefore we decided to go to the island of Djurgården. Because of the

sunny weather, we didn't take the subway but instead walked along the boulevard of Kungsholmen with Stadshuset at the end, where we weren't exactly the only ones of the group.

At Sergels Torg we took a tram, passing the Vasa museum and Skansen which we would see the day after, to its final stop and started walking. We first walked along the waterside, seeing cottages and their gardens, the mill, a little harbour and a gazebo where we had lunch. We continued into the park and saw the orchard and the Rosendal Palace. Then we hiked a bit through the forest, taking a break halfway to sit on the rocks. For our return trip we took the bus (almost full of seniors), also driving nearby the radio tower some of the other students ascended (the golden part of it contained a restaurant).



Back in the centre, we first went to the Hard Rock Cafe. We couldn't get a table to have drinks, so after Bart bought a t-shirt for his collection, we strolled on, looking out for places to go to dinner. After vetoing a dozen restaurants on our way, we entered Jensens Bøfhus which we liked, despite the use of a non-Swedish letter in the name. Unfortunately to get a table we would have had to wait some time, so we left again. Luckily we soon found Stockholm's other branch of Jensens Bøfhus which did have a table for us. After sitting down, Edo received a text from an unknown sender that recommended the nachos. It turned out to be Samantha, who was sitting a few tables away with Mathilde and Marjolein after a full day of Skansen. While waiting for our main course, we saw Samantha getting a piece of cheesecake. Edo asked her how it tasted by text, but he got the response "*Mag niet van Mathilde*", which we got to use very often afterwards. Samantha proposed they would wait for us so the eight of us could go somewhere for drinks after. We ended up waiting for them instead.



After getting ice cream in the street (with Daim!) we went to The Dubliner to enjoy a glass of beer/soda/cider, a game of boerenbridge and the good Irish live music. A nice end to a relaxed Saturday.

Onno van Dillen

SUNDAY APRIL 29TH, STOCKHOLM

DAY TRIP TO VAXHOLM

Just as on Saturday, there is no scientific program for today. There is however another activity scheduled. Today we will take the boat to Vaxholm (pronounced as Waxholm). With a lovely morning sun we arrive at the Grand Hotel where our boat will leave. We travel with a ferry that will sail through Stockholm's archipelago. Regular guided boat tours only cover the waters and islands near the city centre. This ferry gives us an excellent opportunity to explore the wider surroundings of Stockholm.

As we set off, there still is a lovely sun. But on the water, there is a strong wind. Especially Lena looks like she is freezing. We sail along some industry near the suburb Nacka (I keep whistling *Nacka, Nacka*) as we first see the rocky islands with trees, trees and trees. But soon we also spot some desolate red cottages on the rocks and some of us immediately fell in love with charm of the coastline.

As we sail further from the city centre we come to more open water and also to more islands. Even the smallest islands seem to have a red house on it and one small island seems to have a bus stop. Vaxholm is not the first stop of the boat, so we moor on some other (small) islands where there seems not much to do. But it gives us the opportunity to have a closer look at the cottages.

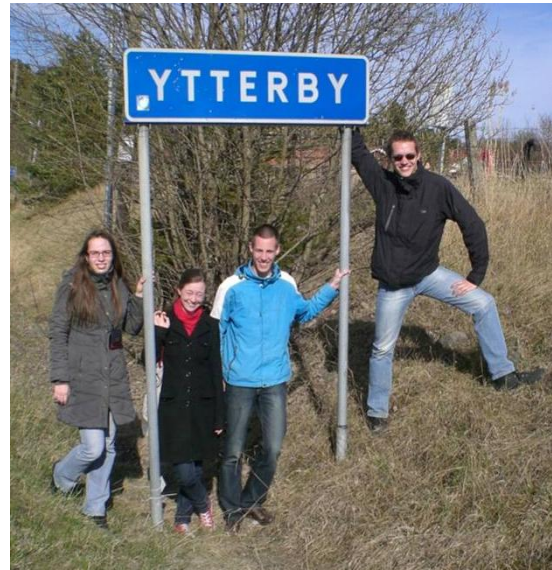
After almost one and a half hour we arrive in Vaxholm. There the group splits and we explore the island in smaller groups. Our group first takes a look at Vaxholm Castle, a not-so impressive fortress from the 16th century. A plate tells us that after building the fortress it was tested for its capability of withstanding cannon fire, which it failed, so it had to be rebuilt right after it was finished. Later Onno would reveal that this specific fortress was used in the movie "*Pippi Langkous in Taka Tuka Land*" which really excites Clara.

After walking through the town (which turns out to be really small), we lunch at the coast with a larger group while watching at some natives going canoeing on the (presumably) ice cold water.



Later, we meet another group who are playing mini golf with Martin, who is a very enthusiastic player, but the competition was, even though using other rules, won by Colet. With a small group we continue our trip with a small bus ride to Ytterby where we want to search for the famous mine in which 7 new elements of the periodic table were found.

Firstly we take a nice picture with us at the city name plate. Then we start our quest for the mine. In the town we see the preparations for a Walpurgis party and there are some boats on top of the hills (why would you do that?), but no sign of the mine. Slightly disappointed we wait at a bus stop to go back to Stockholm. When the bus arrives it turns out that the whole group except for Roland had been in Ytterby. The other groups did find the mine. It was located in the north-eastern part of the island, where we thought it could not be. As a comfort for us, we did find the Tantalvägen and Gadolinitvägen (named after two of the elements found at Ytterby) which the others hadn't found. On their way to the mine, the other group found a third street named after an element, called Yttriumvägen. The habitants of Ytterby had warned them that there wasn't much to see at the mine. But when they arrived at the memorial plaque, almost everyone wanted to have a picture of him/her with the sign of this memorable place. Martin had tragically forgotten his camera so others needed to take pictures for him.



The mine itself was in a very steep hill, so the group had to risk their lives to see the place where the entrance of the mine had been a long time ago. Because of the beautiful view from that place, the group decided to go up even further. Many pictures were taken with the amazing overview of Stockholm as the background.

Merijn Blaakmeer & Inès Penders

MONDAY APRIL 30TH, STOCKHOLM

VISIT TO ORGANIC CHEMISTRY (STOCKHOLM UNIVERSITY) & WALPURGIS NIGHT AT SKANSEN

Today we got up with pain in our lower back from the mini golf, but with a happy feeling in our hearts, because today we will visit Organic Chemistry! We will first visit Stockholm University (SU) and then we will visit Skansen for Valborg (Walpurgis night).

After breakfast we hurry to the Tunnelbana (Swedish for subway) and in no time we arrive at the Arrhenius Laboratoriet. We are welcomed by a post-doc who turns out to be Dutch! Well he did his PhD in Paris so he has not been to Alkmaar for some time which is clear from this strange accent when talking Dutch. Unfortunately we did not get coffee, but we did get a lecture by the dean of chemistry! His function is similar to what Floris Rutjes, our educational director, is doing. Hans Adolfsson, the dean, tells us about the organization SU, not much about the research. After 45 minutes we leave with our heads filled with little facts. The most boring way to present them is via a sum:

- Almost 33% of the funding of SU comes from external sources
- There is 1 bachelor in Chemistry with about 125 students in total
- There are 10 master programs
- The department chemistry consists of 5 research groups (Organic Chemistry is one of them)
- For EU students, studying in Sweden is free, for non-EU students it is 140.000 SEK/Year
- Average group size in the chemistry department is 10 people, prof/PhD ratio \approx 1:1

Thankfully we then got a tour around the lab. It is totally different from our labs in Organic Chemistry. Ours are tidy and safe. Here in Stockholm lab coats are not obligatory and there are no safety cupboards. The hoods contain wood and liquids are stored on the bench. But everybody is nice and their NMRs are all ultrashielded. We did not see the whole department, because we then walked a bit around the campus ending in the SU restaurant. Some of us preferred a good kebab, but most of us ate a good Stockholm lunch.



After sunbathing a bit we went back in and we listened to 3 lectures. Some of us were less entertained (Onno). The first lecture (by Marinus Bouma) was about hypervalent iodine compounds which turn out to be quite versatile C-C coupling reagents. The second lecture was by Antonio Gomez about metal catalysis with transition metals. He spoke about homogeneous catalysts and also about the Metal Organic Frameworks (MOFs) which he believes are the future of catalysis in industry. He talked about the characterization and about the reactions one can catalyse with MOF's. Björn Åkermark is a (retired) professor who told us more about artificial photosynthesis. The talk was very similar to the one we got in Uppsala. In principal we want to oxidize water to H₂ and O₂, the problem is that everything is oxidized with this process. Actually new oxidation methods are

developed as side products in this research. We did not have any problem listening to Prof. Åkermark.

At the end of the afternoon we went to Skansen for the celebration of Valborg. Skansen is world's oldest open air museum and it consists of several typical Swedish buildings which are rebuilt in Skansen. There are also typical animals naturally occurring in Sweden. We saw for instance brown bears, wolverines and moose, which became the dinner for Daniël and Martin. All and all a very nicely set up park, definitely worth the money. In the evening we celebrated Valborg here. The celebration of the spring! The sunset was beautiful and after a speech we did not understand, a pile of wood was set on fire. This resulted in a huge fire which we all enjoyed. I am certain that the bad spirits are all gone for the summer. Let's hope that this fire saves Stockholm from some spring snow.



Ruben Tent & Colet te Grotenhuis

TUESDAY MAY 1ST, STOCKHOLM
VISIT TO NOBEL MUSEUM



The first of May is an official festive day in Sweden, the Workers' Day. We went to the old town of Stockholm to visit the Nobel museum, the only official activity of this sunny Tuesday. The Nobel Museum is embedded in the beautiful old city centre of Stockholm and located in the former stock exchange building. Guided by a professional guide we learned about the history of Alfred Nobel, his lifetime achievement and the story of the Nobel Prizes. He was a genius mind who achieved 355 patents and invented different things, e.g. dynamite. The dynamite was not only intended for peaceful usage as the received presumption is even today. Alfred Nobel was also involved in the improvement of dynamite for the usage in warfare.

Unfortunately the exhibition about Marie Curie closed some days before our visit. Marie Curie was the first woman who received the Nobel Prize and one of the four multiply honoured Nobel Prize winners. The permanent exhibition of the Nobel Museum shows the history of the Nobel Prize and is based on many different cinematic documentations. The documentaries, shown in two small cinema rooms, illustrated the work and the laureates of the Nobel Prize winners. The short documentaries of about 5 to 10 minutes were in the style of art house films. In the hall of the museum touch screens were installed which showed the history of the Nobel Prize and a short summary about each winner through the decades. Also, in the floor screens were installed which showed the most important events of each decade in a few minutes. At an installation on the ceiling small posters were representing each Nobel Prize winner. These posters were rotating through the hall of the Museum.



The Nobel Museum also has a small café, where most of the chairs were signed by the Nobel Prize winners.

The Rest of the Day was free and the most of our study group were visiting the old town and the activities of the workers day all around the city centre. There was a big protest march with red flags and thousands of participants. Furthermore the whole city was flooded by people watching the protest march or just enjoying the sunny day free of work.

Jan Nabers



WEDNESDAY MAY 2ND, STOCKHOLM/OSLO
TRAVEL TO OSLO

Wednesday morning we had to get up bright and early to pack our bags, have breakfast and check out of our hostel by 7:45. We took the T-bana to central station and boarded the train that would take us to Oslo. The trip itself took about six hours and was largely uneventful - bar the man wandering up and down the carriage, sometimes tripping over Tjeerd's feet. He wore a beret and looked like he had drunk a few too many glasses of wine, therefore we named him Pierre. Travelling by train did, however, allow us to enjoy the beautiful scenery in both Sweden and Norway in comfort. I am really glad we got to experience it rather than a boring plane ride.



We arrived mid-afternoon in sunny Oslo to blue skies and a temperature of twenty degrees. After taking the 'scenic' route, we arrived at our hostel: Anker Hostel. We then headed towards Vigeland Sculpture Park, a beautiful park that was packed with people enjoying the weather. There we joined Norwegian students from Proton for a barbecue in the sun. They were very nice and chatty, and some of us were brave enough to join the ones doing a game of throw and catch with a frisbee. Meanwhile the meat had to be prepared of course, and a somewhat unexpected helping hand was stretched out by Roland Brock, who did this barefoot.

After dinner we had a small photo shoot at the Monolith Plateau to satisfy our sponsors. Despite the very pleasant temperatures, all of us had to wear our study tour hoodies. You can see some of these pictures throughout this book. Unfortunately Onno had left the SNUF banner in his suitcase so we needed to plan another photo shoot later on as well.



When we returned to the hostel, a few of us decided to explore the city of Oslo. We did not head towards the city centre, which we would be visiting on Saturday, but walked towards Olaf Ryes plass. There we had some of the best ice cream I have ever tasted, with

flavours including espresso and mango. We ended our day by walking back to the hostel along the river Akerselva.

Mathilde Castelijns

THURSDAY MAY 3RD, OSLO

VISIT TO LYTIX BIOPHARMA & LIFE TECHNOLOGIES / INVITROGEN DYNAL AS

The first morning in Oslo already started with some minor problems. The restaurant in which we were supposed to get our breakfast was closed. We had to wait a full twenty minutes before the owner had arrived and we could finally have breakfast; only fifteen minutes left to eat, impossible. So it happened that we were already ten minutes late for our first visit in Norway; Lytix Biopharma, which was located at the office park Forskningsparken in Oslo. They gave several presentations about the company itself and also about their two lytic peptide drugs.

The company started with the discovery of Lactoferricin B (Lfcin B), a small actin part of Lactoferrin. Lfcin B that works as a cationic antimicrobial peptide (AMP). The first Lactoferricin B derived small AMP is LTX-109™. This drug uses a whole new target as compared to classical antimicrobial drugs, it does not target the cell metabolism, but instead targets the cell membrane, which is essential for cell survival. The advantage of this, is that the drug has a low potential for developing resistance, however it also means that it has to have a very high selectivity. It causes rapid bacterial cells lysis, stimulates cells of the innate immune system and works for an unusual broad spectrum of microbes; from gram-positive/negative bacteria to fungi and viruses.

Another drug that is derived from the Lactoferricin B protein, is the anti-cancer drug LTX-315 (Oncopore™). A new chemotherapy is highly needed, as classical chemotherapies have the problems of being non-selective, suffer from high resistance, and induce immune-suppression. Lfcin B showed to induce tumor regression, and thus posed an interesting candidate as anti-cancer drug. The drug induces necrosis of tumor cells. In addition to this, it also causes the release of danger signals and the invasion of immune cells in tumor, which protects against relapse of the tumor through this mechanism. Due to the fact that when LTX-315 is used in normal cells, a minimal number of cells die, it can also be used as an adjuvant, as enough danger signals are released to induce activation of dendritic cells and uptake of antigens from the tumor vaccine. This seemed to work very well combined with tumor cell-lysate vaccines, and also protects against tumor relapse.

After the presentations at Lytix Biopharma, we had some time off before we had to re-group at Blindern Metro station. Our group spent the two hours having lunch in the sunny grass. We also went up to Holmenkollen Metro station to visit the Holmenbakken ski jumping hill, but had too little time to go all the way up to the jumping hill. Fortunately for us, we planned to visit it on a later day. Back to Blindern station to take the metro to Montebello station. We then visited, at around 14:00h, Life Technologies / Invitrogen Dynal AS.

After a brief introduction by the head of the R&D department the first talk was presented by Geir Fonnum, research fellow at Life Technologies. The subject of his presentation was "Magnetic Beads: A key enabler for bioseparations, diagnostics and sequencing". He explained in detail how the magnetic beads are produced and their characteristics. He also talked about the applications of Dynabeads in molecular diagnostics and gene sequencing.

The second talk was presented by prof. dr. Roland Brock. He talked about “Cell penetrating peptides for molecular delivery”. He presented several drug delivery strategies and CPP characteristics. He also discussed the chirality dependence and applications of CPP.

The third talk of the day was presented by dr. Martin Feiters. Martin had assumed that he did not need to give a presentation anymore at Life Technologies, but when he realized during lunch he had confused several emails, he prepared a presentation. This went very well. The subject of his talk was “Copper and Click reactions”. He discussed Cu-catalysed and Cu-free click chemistry which was of great interest of Lytix. Cu-catalysed click reactions are used in for example the synthesis of Ir-ligands. Cu-free click reactions are mainly used for biological applications.

The fourth and final presentation of the day was given by Karoline W. Schjetne, PhD staff scientist, about “Dynabeads for cell therapy”. She talked about the applications of dynabeads in the fields of immunotherapy and regenerative medicine.

After the presentations there was a guided lab tour. We visited several of the onsite facilities used for research applications.

In the evening, several small groups made dinner for themselves. Each room had its own kitchenette, and pans and dishes could be loaned for a deposit at the reception. The rest of the evening we spent playing the game “In de pan” (or “in de etui” in this case), which for a large group became the game that was played most of the evenings.



Edo Luijten & Roy Awater

FRIDAY MAY 4TH, OSLO

VISIT TO CELL BIOLOGY & TUMOR BIOLOGY

For the second time in a row we went out to have breakfast at the restaurant next door only to discover that it was again closed. Luckily, the hostel could arrange a breakfast at the Anker hotel. Unfortunately, we only had 30 minutes to enjoy this very fancy breakfast, because we had to be at the University of Oslo at 9:00 AM sharp. We first visited the biology building, which was built in the early 70's and displayed many stuffed Scandinavian animals.



We were welcomed by Gunnar Dick, who gave us some historic information about the 201 years old university. He also told us about the Norwegian study system, which is similar to the Dutch system, except that they finish high school at 19 years old and PhD students get paid a lot more (€45.000 a year). Nevertheless, expenses for subsistence are also much higher than in the Netherlands.

Gunnar also gave us a short introduction on intracellular transport by glycosylation of proteins and their importance for development and patterning of the multi cellular organism. Their research was mainly focused on determining different glycoprotein and proteoglycan structures and the effects thereof on intra- and extracellular localization. We were then split up in three groups to hear more about the different techniques they use to study glycosylation. One of these techniques is HPLC (High Performance Liquid Chromatography) which is used to purify different glycoproteins which are subsequently analysed by mass spectrometry. An introduction on HPLC and a tour through the lab were given by Frøy Grøndahl and the general principle of mass spectrometry and the interpretation of the results were then explained by Anders Moen. Finally we got to see their brand new microscopy department, where Linda Hofstad Haugen made us familiar with a confocal microscope. Some of us even got to help her with the demonstration of fluorescent labelling for localization of different proteins.

In the little time we had left we travelled by metro to Oslo's Radiumhospitalet, which was situated in a very modern building. We were welcomed by Ola Mykleblost, the group leader of Tumor Biology, and brought to the canteen, where the salad bar was waiting for us. We had plenty of choice to fill our plates with food, and afterwards it was weighed at the sales counter and the all-time lunch-meal record was set by one of the participants of the study tour at 1.333 kg.

After this satisfying and refreshing meal we were guided into a lecture room which deserves the price for best lecture room of the tour. Huge chairs enabled us to feel comfortable and to listen with maximal intensity to the first speaker of the afternoon, Leonardo A. Meza – Zepeda. During this lecture he told us that all cancers are different, they all possess a different genetic signature. Due to these differences in the genetic profile of the cancers he suggested it is better to have personalized cancer therapy. In order to optimize this he was setting up a database containing specific mutations in certain types of cancer and treatments against this cancer. As an example, a mutation in the epidermal growth factor in lung cancer was mentioned, and from the database it was derived that treatment with the drug Pertuzumab was most effective. Only downside to this database was that it was limited to patient data from Norway only, however it would be possible to collaborate with other countries in the future. The next talk was by Susanna Lorenz and she told us about her research regarding sarcomas. She was doing RNA and DNA sequencing on sarcomas and was interested in fusion genes. Currently 8 fusion genes were confirmed by RNA and DNA sequencing and she was expecting more to analyse, however she was limited by budgets.

After this talk it was time for a small lab tour, where we saw the modern facilities. What struck my attention was the fact that the offices of the staff were located inside the lab, something I (Tjeerd) hadn't seen before. Apart from the DNA and RNA sequencing machines the lab contained standard biochemical lab material, only situated in a more modern facility. After lunch there were four more talks, however the two weeks of hard work and the relaxed chairs were paying its price, the energy and focus level of the group dropped tremendously. Luckily Ralph and Luc were spraying with (good) questions!

At five we were done with the hard work and we moved over to the University Campus to enjoy a BBQ with the student association Realistforeningen. In a cosy underground pub we drank some reasonably priced beers and ate our dinner which consisted of sausages and spare ribs and little pancakes. At seven a pub quiz started, however questions were really Norway-related and therefore hard for us to understand. Some questions were doable, and if I'm correct everybody knew the Pokémon Oddish. At nine I left the university and went back to the hostel, where I refreshed myself, drank some Coke and enjoyed Oslo's nightlife in Grønland.



Samantha van der Beek & Tjeerd van Dijk

SATURDAY MAY 5TH, OSLO

CITY TOUR OSLO

We all had a little trouble getting out of the door. Breakfast was (unfortunately) on time today, but it was clearly weekend, as we all were a bit slow. A little late, we took the tram to the city hall of Oslo where we would get a tour of the city highlights. Our guide Yahel was already waiting for us and was still cheerful. Yahel is originally from Israel, but moved to Oslo to live with her husband and to study Arabic. We could unfortunately not go inside the city hall, because of an important ceremony that took place inside. However, Yahel could tell us interesting things about the city hall and about the



history of Oslo and Norway. Norway has been part of either Denmark or Sweden throughout a couple of centuries. Oslo had burned down a couple of times because of different attacks by the Danes and Swedes and was finally rebuilt on the other side of the hill by king Christian of Denmark.

After this introduction to Norwegian history, we began our walk through Oslo. The first stop was the National Theatre (until now only known as metro station), where we admired a statue of Henrik Ibsen, a famous Norwegian poet. A bit further down the road, we walked past Ibsen's house that is turned into a museum. Every day, Ibsen walked from his house to the grand café and on this route, you can read famous quotes from his work on the sidewalk. Even more interesting than the details of Ibsen's life was that we finally learned why the traffic lights in

Oslo have 2 red lights instead of one. Some say this would make it easier for guide dogs to see the lights, but the real reason is probably that these traffic lights were cheaper than the normal ones.

Next, we walked past the palace of Queen Sonja and King Harald. Here stands a statue of the Swedish king Karl Johan XIV. Karl Johan is a born Frenchman (from the house of Bernadotte) who changed its name to Karl Johan when he was adopted by the childless Swedish king Karl VIII. Karl Johan was apparently a nice guy who was very popular in Norway. The royal family is under discussion lately, but the king and queen are still very popular, as is the heir to the throne Haakon. Haakon married a 'commoner' with a child of a drug addict... all very romantic. The Norwegian people like traditions, such as the national constitution day on the 17th of May. On this day the independence of Norway is celebrated with a children's parade and many student parties.



After a nice walk through the city, along Ibsen's café and the parliament house, we had a little time to climb the roof of the opera house, a modern building that is supposed to resemble an iceberg. Standing on the roof, we had a very nice view of Oslo and the Oslofjord. Our guided tour was concluded after a quick look inside the opera house and a view of the fortress of Oslo.

After saying goodbye to Yahel and searching for a supermarket, we took the boat to Bygdøy, where



we would visit the Viking ship museum. Here 3 ships are on display which are very well preserved because they were buried together with dead Vikings and their pets. The three ships had served different purposes, for example, the Oseberg ship had been a royal pleasure craft and the Gokstad ship was used to sail the high seas. The museum also had an interesting collection of Viking equipment and aside from the mistakes in drawing a DNA structure, the museum was worth visiting.

After this long day of walking, our feet hurt and we decided to just cook at the hostel and play some games. These games included again "in the etui" which involved imitating Queen Sonja, Yahel and other persons we encountered

during our study tour. Even then, we continued to learn new things, such as Clara's talent for mimicking people, Daniël's talent for eating lasagne and that Esther is almost always a werewolf.

Marjolein Baar

SUNDAY MAY 6TH, OSLO

DAY OFF

This Sunday finally brings a morning without alarm clock-forced wake-up.



First point on the improvised agenda is visiting the Holmenkollbakken ski jump tower in the town of Holmenkollen, reachable –as always– by the lovely Scandinavian *T-bane*.

Stepping onto the platform with about a fourth to third of all students, the path goes up a rather steep hill which soon turns into the even steeper Holmenkollbakken. Arriving halfway up the ski jump, we discover a shop and a cash desk instead of a way to the top. It

turns out that riding an elevator is the only way to reach the top, and it costs an equivalent of over €10 to use it. This payment also grants access to the Ski Museum, but no one seemed to care much about that and therefore only a few people (Edo, Ruben & Merijn) actually made it to the top to see the beautiful view over the city.



Second target: a lake called Sognsvann, in a forest just to the north of Oslo. That this is another popular location, especially with the nice weather, is proven by the number of tourists that sit and walk around the water. To avoid the crowded path, our now smaller group decides to flounder

through the foliage next to it, granting us an inside look at the Scandinavian woods, as well as a wet-feet surprise thanks to swampy moss for some of us.

Having walked around the lake and appreciated the Norwegian middle-of-nowhere toilet at the lake, we decide to return to the city centre and -because we found that it would close in 10 minutes after our arrival- not enter the National Museum before heading back to the hostel.

Where Bart and a small group of people chose Sognsvann to be their second location after seeing the ski jump tower, me (Luc) and other people chose to take the T-bana in another direction to see the National Gallery in Oslo. This is a museum well known for holding a wide variety of paintings, drawings and sculptures, but especially for holding one of Edward Munch's *Scream* and *Madonna* and also several paintings of Cézanne and Manet. Where a part of the group was finished with looking at paintings in half an hour (barbarians), me and other people took our time with examining the paintings thoroughly.

When everyone was finished looking at the paintings, a part of the group decided to go back to the hostel and already pack their bags for the day after, the rest decided to see more of Oslo. Being refused to enter the City Hall which was closed due to some ceremony we went to the fortress near Oslo harbour. Quite surprisingly it still contained some unique features being well worth the time visiting. After a funny incident involving a girl of the group drawing the attention of an Oslo guard, we decided to leave and head back to the Hostel to meet again with the other groups.

Pretty much the whole group decided to eat at Nilsen Spiseri, a small restaurant in the centre of Oslo providing a discount on Norwegian meals for people staying at our hostel. Here Daniël ate whale (which tasted good) and Samantha, Edo and Merijn had reindeer (which was hard-bitten) After a good meal, we are asked to pose for a for the restaurant's Facebook page. Though the picture has not been found on the internet yet, you may find our smiling faces and study tour hoodies on one of the restaurant's websites soon!

Bart Borghans & Luc Depré

MONDAY MAY 7TH, OSLO

VISIT INSTITUTE FOR ENERGY TECHNOLOGY & FLIGHT HOME

A shy sun shone its first bright rays, though only just visible, over the rim of the horizon as Oslo awoke soaking up the spit of the capricious Thor. The disenchanting drizzle that steadily poured down drowned the early signs of summer we now found to be mere memories. Nevertheless, optimism soared through the by presentations and parties prostrated participants as breakfast was for once served nearly on time. Spurred on by



this seldom seen something-close-to-punctuality of the Breakfast Guy, everybody swiftly started to pack their bags for the return journey. Before we would fly home to good old Gouda cheese, a visit to the Institute for Energy Technology had been planned. In small groups we took the tram to the Central Station, of which the Norwegian spelling still caused some giggling. After assembling for half an hour – by coincidence the same time polymersomes need to assemble – we travelled to Lillestrøm by train. There, we left our luggage in a locker, and took a bus to Kjeller, where the Institute for Energy Technology is situated.

We were heartily welcomed with an urgently needed cup of coffee. When the drowsy eyes sprung open after their fresh shot of caffeine, the presentations took off. We were told that the Institute has had a long history of cooperation, dating back to its founding years in the 1950s, with the Netherlands. At the Institute, scientists are working hard to find answers to global warming. They envision that it is possible to put the globally increasing CO₂ levels to a halt. Currently, the Institute is working on CO₂ capture and storage systems, and even on a chemical reaction where CO₂ is consumed and H₂ is formed. Furthermore, hydrogen storage is also a key research area for the Institute. The Zero Emission Gas (ZEG) technology got some special attention by a nice video, which was maybe a bit too convincing for the critical academics. By building ZEG power stations, the Institute hopes to provide a better future without CO₂ emission, while all cars run on environmentally friendly hydrogen.

In addition, the Institute invests in research on solar energy. Scientists produce and characterise new kinds of wafers, to obtain higher efficiencies for energy transmission. This is part of a large collaboration within Norway, which of course means that hydropower is used to produce the new solar cells. Was it the Normans who brought the ancient art of irony to England in 1066?

After an exquisite lunch, where the hungry students and supervisors ate all the luxurious sandwiches before you can say “pentahydroxy-*para*-vinylbenzene” ninety-six times, we split up in two groups for a visit at two research sites. One was an interesting laboratory where they produced the wafers for the solar cells. However, excitement came to a climax when we entered one of the nuclear reactors of the Institute, which is used for characterisation studies. The radioactivity levels inside the reactor were lower than in the centre of Oslo, our guide Roberto assured us. In fact, the presence of a small Tigger doll added some fluffiness to the cold metal room.

After these exciting talks and tours, we went back to Lillestrøm, where we picked up our luggage and took the train to the airport. While flying away from our adventures in Sweden and Norway, which were now imprinted in our memory next to the early summer, a curiosity that was so characteristic of this study trip tortured both the students and the supervisors. Even though hundreds of questions had been asked during the many presentations, numerous remained. How many cups of coffee did Krista drink during this trip? How did Ralph earn his cowboy hat? Who had the smelliest shoes? (oh no, we all know that, my apologies once again) Was Ruben or Martin the Master of Minigolf? How can a throat used to yelling still ache Daniël?

Possibly, we will never know the answers, since what happens on the study trip, stays on the study trip. And in this booklet, perhaps. All I can say is *venimus, vidimus, rogavimus* – we came, we saw, we asked. During this trip, all participants have shown that they were true academics. Never taking anything for granted, the number of questions has been significant, although I cannot provide you with error bars nor a linear regression to underpin this statement. We are stronger than the early sun this story began with. We can break through the clouds and drizzle that mystify and blur our sight. We can do more than mere observation, we can envision.

Finally, I would like to thank the committee for organising such a successful, interesting study trip with lots of variation and fun. The supervisors, Martin and Roland, really blended in with the students, having dinner with them, watching snooker, and cracking jokes, which was all much appreciated. Most importantly, the greatest deal of gratitude should go to the entire group. The study trip meant to me two weeks of science and culture, but it is all deprived from any value without the friendship and cheeriness we have seen from all participants. Thanks a lot.

Sjoerd Postma

COMMITTEE REPORTS

CHAIRMAN

When the study tour committee was formed, I joined the study tour committee because it seemed like a very interesting challenge. There also was a matter of urgency forming the committee, because otherwise there was not enough time to organize the study tour. After a quite hectic beginning of forming the committee our first task at hand was choosing our destination. Due to a lack of financing for the tour we had to choose countries within Europe. Quite convincingly Norway and Sweden were chosen based on votes from all the participants.

The next task at hand was finding supervisors and funding for the study tour. We asked Roland Brock and Floris van Delft to join us. They both accepted our invitation, but when Floris van Delft was not able to join us anymore, we were very happy that Martin Feiters was very enthusiastic to join us. To get as much funding as possible we tried to get as many case studies as possible. We did this by appointing a group of departments to each committee member with task to ask professors for possible funding in exchange for work, this resulting in a record amount of case studies.

Besides this we also had a symposium in advance for the study tour to organize. As a tradition we had people from Norway and Sweden telling us about their countries and what to expect. When I mailed an invite to the Norwegian embassy, they immediately responded enthusiastically. Tonje gave us a very lovely talk about Norway, thank you very much. But with the Swedish embassy not reacting, we had to think of another option to get a native Swedish speaker. We did this by asking the international office for Swedish students studying at our university. After mailing these students, two reacted and were happy to give us a talk. I would therefore also like to thank Ulrika and Jonas for giving a nice talk.

In the last few weeks for the study tour we had to work hard to finish everything on time. But it all worked out and we had a great study tour.

With this report finishing the study tour of 2012 the only thing left to do for Me, Merijn and Onno is to find a new committee for 2014 and hopefully pass the spirit to them to organize such an amazing study tour.

Luc

SECRETARY

When finally our committee was being formed, there were two candidates for the post of secretary: Samantha and myself. Because Samantha withdrew, there was no voting needed and I became the secretary of our committee. We then found our seventh committee member in Bart and thus we could start organizing the study tour.

Besides some general tasks that we did with the whole committee like finding a suitable destination (both countries and cities), asking for case studies and arranging transport and places to sleep (yes, I'm responsible for our lovely hostel in Stockholm, but in my defence, it was the only hostel that reacted to my emails), I also had some specific duties. My main task was writing the minutes after each meeting. Although I've done it with pleasure, I'm happy that this weekly task has ended. Included in writing these minutes was to make up on list of action points for the different members and making sure that everybody executed these action points.

Besides this I had lots of other tasks including compiling a Board of Recommendation, checking the mail box, sending emails to the participants, planning the transport in Stockholm. In the end I also assisted Bart and Ralph by taking care of some of the visits.

Fortunately our tour went pretty smoothly. The biggest problems concerned the breakfast. When this happened for the second day in a row in Oslo, Martin became angry at the reception and the receptionist allowed us to have breakfast in the accompanying hotel and so this was solved.

Organizing this study tour sometimes yielded some stressful moments, but it was worth it. Being a committee member has its advantages since you have influence on the program and destination and that makes the 'anticipatory pleasure' bigger.

Finally I would like to thank my fellow committee members for organizing this study tour.

Merijn

TREASURER

This was the first time I had the duties of the treasurer (or any committee for that matter) so things were all new to me. This may have contributed to the fact that I sometimes visited the bank (almost) in vein. I liked having an overview of the costs and calculating how expensive the tour was going to be. I was a bit anxious in the beginning, because there were a lot of invoices to be paid and there weren't that many resources yet. A lot of case studies were arranged, but it would take quite some time before most of them were paid. In the end it turned out fine, mostly due to the hostels not demanding much to be paid ahead.

While on tour, most things went fine. The situation at the lockers in Lillestrøm station was not ideal, but as always there was a solution. After that, we saved some money because the bus had a broken system. That did result, however, in a fair amount of cash without purpose, which meant a visit to the GWK for me. But with the end in sight this didn't really matter to me anymore.

Of course I also had some other tasks, such as creating the website and keeping it up to date. Yes, by the end the updating became a bit slow, sorry for that. Other tasks include the name tags for the symposium, handing out travel guides, researching boat tours, walking with a box full of sweaters, planning bus trips and putting the times in our 'Draaiboek', etc. I was glad to be a part of the committee, for the experiences gained and to have helped to make the study tour possible.

Onno

TRAVEL COORDINATORS

When the preparations for our study tour 2012 began, the total committee was split-up into sub-coordinators. Bart and Ralph decided to accept the challenge of putting the programme together which meant contacting various research facilities and looking after cultural excursions. After contacting people at companies and universities that might've been able to host us, most of them sadly declined due to a lack of R&D/factory-departments suitable for us to visit. Together this programme is of course more or less the heart of our study tour and we started realising that this indeed was a long-term challenge.

We started around April 2011 with the framework of our study tour by determining the different cities to visit and setting up the overnight stays. Without much discussion we decided that the study tour 2012 must visit both capital cities (Stockholm and Oslo) and in addition we were charmed by the student-city Uppsala. In order to book all the hostels, flights and bus/train tickets between these cities, we contacted several travel agencies. Unfortunately, all three options were via OAD and thus were more or less the same. We chose to continue with one of these, via the ANWB, which only needed some minor changes such as downgrading the 5-star hotels to student priced hostels. After a long period of waiting and asking, we had seen at least seven versions of their offers. None of these included all our wishes but the prices were always quite high. For this reason and with a last push from our supervisors we decided to stop this time-consuming process and start looking for hostels/flights/train-tickets ourselves. This had made us emailing a lot, but fortunately we were able to organize everything via the internet.

Around the time we had made our planning and started booking the hostels ourselves, we also contacted different companies, departments of the university, student organisations, museums and more. Thanks to different contacts of our supervisors, and also those of Floris van Delft, who was unable to join our tour and was replaced by Martin Feiters, we could already agree on several different visits. What we have also seen, is the diversity of reactions by which some departments/companies wanted a special motivation and information about our background and the connection between them and us. Gradually we could fill the program, until only some parts stayed open such as Monday 30th of April. Planning visits on Saturday through Tuesday (April 28, 29, 30 and the first of May) turned out to be quite difficult. The weekend ends in two consecutive holidays: Walpurgis Night on the 30th to celebrate the transition of winter to spring, and the day after that is May Day, their version of International Workers' Day. Most of our contacts had understandably declined the suggested dates above, intending to take the day off like many of their colleagues. We were eventually lucky enough to have Mrs. Berit Olofsson agreeing to let us visit her Department of Organic Chemistry at Stockholm University on Friday the 30th of April. Berit, however, was pregnant during these negotiations. She predicted that she'd be on maternity leave during our study tour, as her due date was only a few weeks before we departed to Sweden. We were very happy to hear about her Dutch postdoc, Marinus Bouma, who ended up hosting our visit. After a lot of puzzling and maintaining our contacts of the visits, we only had to make an overview of the bus lines and a precise time-schedule. Putting all this information in a little booklet, we made a participant version and a committee version with all our preparations. Together we had a great study-tour with lots of variation and no (big) problems. All of our planning developed smoothly during these two weeks and it even exceeded our expectations!

Bart and Ralph

SPONSOR COORDINATORS

In order to make our study tour possible, we needed external funding from sponsorships. The journey to find as many sponsors as desirable was long and not always easy, but we are really delighted with the outcome. We contacted many chemistry and life science related companies and writing all these letters and concentrating on the different backgrounds of companies was very constructive for us. Many companies also became enthusiastic about our study tour and wished us good luck with the organization. Unfortunately, most companies couldn't sponsor us due to the economic crisis. Some companies also have their headquarters abroad, which resulted in the fact that the offices in The Netherlands couldn't sponsor us. Fortunately, this wasn't the case for all the

companies, because besides Dutch companies, we have also received sponsoring from a Belgian company with its headquarters in Switzerland.

We are truly thankful for all the companies who wanted to sponsor our study tour. There was a wide range of sponsor options, from advertisements, to funding our bus trip to Schiphol, and having the company's logo on our sweater. Or we could have visited a branch of that company in Norway/Sweden (if they had one). It was a good thing that our sponsors could choose between these options. We owe our sponsors a great deal for making this tour a huge success.

Mathilde and Inès

FINANCIAL REPORT

Here is the financial overview of our study tour.

| | Revenue | | |
|------------------|------------|----------|---------------------------|
| Amount of people | Per person | Total | |
| 24 | € 357 | € 8,583 | Contribution participants |
| 24 | € 100 | € 2,400 | FNWI funding participants |
| 2 | | € 1,348 | FNWI funding supervisors |
| 24 | € 105 | € 2,520 | SNUF funding |
| 16 | € 500 | € 8,000 | Case studies (€10/hour) |
| | | € 2,140 | Sponsorship |
| 2 | | € 1,348 | Contribution supervisors |
| | | | |
| Total: | | € 26,339 | |

| | Expenses | | |
|------------------|------------|----------|-----------------------------|
| Amount of people | Per person | Total | |
| 24 | € 848 | € 20,354 | Travel participants |
| 2 | | € 2,593 | Travel supervisors |
| 24 | € 57 | € 1,359 | Culture/nature participants |
| 2 | | € 103 | Culture/nature supervisors |
| | | € 732 | Printing costs |
| | | € 134 | Bank costs |
| | | € 20 | Symposium |
| | | € 27 | Chamber of Commerce |
| | | € 520 | Sweaters |
| | | € 37 | Presents |
| | | € 460 | Dinners with associations |
| | | | |
| Total: | | € 26,339 | |

Elucidation:

- Culture/nature: entrance fees for museums and boat tickets
- Bank costs: account costs, credit card costs, currency fees, etc.
- Presents: the personalized clogs we gave to our hosts during the tour
- Dinners with associations: the student dinner with NF (Stockholm), the barbecue with Proton (Oslo) and the drinks at the reunion (Nijmegen)
- Print costs: mostly for the symposium booklet, travel guide and the study tour report
- The travel costs for the supervisors are funded for 50% by the Faculty of Science (FNWI) and for 50% by contribution from their departments.

STUDY TOUR PARTICIPANTS

COMMITTEE

Luc Depré, Chairman
Merijn Blaakmeer, Secretary
Onno van Dillen, Treasurer
Bart Borghans, Travel coordinator
Ralph Slijkerman, Travel coordinator
Mathilde Castelijns, Sponsor coordinator
Inès Penders, Sponsor coordinator

SUPERVISORS

Prof. Dr. Roland Brock
Dr. Martin Feiters

PARTICIPANTS

Roy Awater
Marjolein Baar
Samantha van der Beek
Karen Berntsen
Tjeerd van Dijk
Lena Ebert
Clara van Emmerik
Robert Harmel
Colet te Grotenhuis
Esther van der Heijden
Edo Luijten
Jan Nabers
Krista Polman
Sjoerd Postma
Daniël Schoenmakers
Yvonne Sijssens
Ruben Tent

ACKNOWLEDGEMENTS

Organizing a study tour with a committee which has no experience in doing so, is a big task. Therefore this study tour would not have been as successful as it was without the help of the following people.

COMMITTEE STUDY TOUR 2011

First of all the committee would like to thank the committee members of the 2011 study tour who shared their knowledge in organizing a study tour. So thanks Barbara, Koen, Bas, Sander, Brigitte and Stéphanie.

BOARD OF RECOMMENDATION

The committee would like to thank all members of our board of recommendation for their trust in our study tour

- Prof. dr. F.P.J.T. Rutjes
Professor Synthetic Organic Chemistry & Director of the educational institute of Molecular Sciences at the Radboud University Nijmegen
- Em. prof. dr. R.J.M. Nolte
Emeritus professor Organic Chemistry at the Radboud University Nijmegen, member of the Royal Netherlands Academy of Arts and Sciences (KNAW)
- Prof. dr. G. Vriend
Director of Centre for Molecular and Biomolecular Informatics (CMBI) Nijmegen
- Prof. dr. E. Vlieg
Director of the Institute for Molecules and Materials (IMM) at the Radboud University Nijmegen
- Prof. mr. S.C.J.J. Kortmann
Rector magnificus of the Radboud University Nijmegen
- Prof. dr. C. C. A. M Gielen
Dean of the Faculty of Natural Sciences, Mathematics and Informatics at the Radboud University Nijmegen
- Prof. dr. R.H. Dijkgraaf
President of the Royal Netherlands Academy of Arts and Sciences (KNAW) (until July 1st)
- Dhr. M.F.M. Post
President of the Royal Netherlands Chemical Society (KNCV)
- Drs J. E. Craanen
Dutch ambassador in Sweden
- Dhr R. van Rijssen
Dutch ambassador in Norway
- Mr. Th. C. de Graaf
Mayor of Nijmegen, Netherlands (until February 1st)

SUPERVISORS

The success of our study tour is partly due to the enthusiasm and input from our supervisors, not only in the preparatory stage, but also during the trip itself. They have done a great job in representing the Radboud University during our visits.

We also greatly appreciated the interaction between Martin and Roland and the students.

ALL PARTICIPANTS

We thank all participants for their contributions to the study tour, either through case studies or preliminary studies, and for their enthusiasm during the tour itself

PEOPLE AT THE SYMPOSIUM

We would like to thank our foreign speakers of the symposium: Tonje Olsrud, Ulrika Ehrenstråhle and Johan Svedberg.

We are very glad that we had 'erfaringsdeskundigen' from both Norway and Sweden during the symposium. As no others they have prepared us for the culture and habits of the beautiful countries we visit.

Also thanks to Colet, Daniël and Krista for their presentations about their case studies.

EVERYONE THAT MADE OUR VISITS POSSIBLE

GE Healthcare, Uppsala (Dr. Jos Buijs)

Uppsala University

Department of Bioinformatics (Prof. Dr. Erik Rudloff)

Department of Photosynthesis (Prof. Dr. Stenbjörn Styring)

Karolinska Institute (Prof. Dr. Gunther Schneider)

Stockholm University

Department of Neurochemistry (Prof. Dr. Ülo Langel, Jakob Regberg)

Department of Organic Chemistry (Prof. Dr. Olofsson, Dr. Marinus Bouma)

Sandvik, Stockholm (Helen Eiderborn)

Lytix Biopharma, Oslo (Dr. Øystein Rekdal)

Life Technologies, Oslo (Erlend Ragnhildstveit)

Univeristy of Oslo

Department of Cell Biology (Dr. Gunnar Dick)

Cancer Institute, Academic Hospital Oslo, Department of Tumor Biology (Prof. Dr. Ola Myklebost)

Institute for Energy Technology, Kjeller (Dr. Stefano Deledda)

And all other people in Sweden and Norway who assisted us in arranging visits

ALL THE DEPARTMENTS WHICH HAVE OFFERED US A CASE STUDY

Prof. Dr. Buydens (Department of Analytical Chemistry)
Prof. Dr. Huck (Department of Physical-Organic Chemistry)
Prof. Dr. Kentgens (Department of Solid State NMR)
Prof. Dr. Wijmenga (Department of Bio-Physical Chemistry)
Prof. Dr. Rutjes (Onderwijsinstituut Moleculaire Wetenschappen)
Prof. Dr. Van Hest (Department of Bio-Organic Chemistry)
Prof. Dr. Rowan (Department of Molecular Materials)
Prof. Dr. Vriend (Department of Bioinformatics)
Prof. Dr. Brock (Department of Biochemistry)
Em. Prof. Dr. Nolte
Dr. Floris van Delft (SynAffix B.V.)

OTHERS

- Jan Nabers for the committee photo
- Our grant providers: SNUF and the FNWI of the Radboud University Nijmegen

SPONSORS



Lonza



COLOPHON

Stichting Buitenlandse Studiereizen, Nijmegen

t.a.v. Study Tour committee 2012
Heyendaalseweg 135, Postvak 57
6525 AJ Nijmegen
The Netherlands

studiereis2012@science.ru.nl
<http://www.studiereismw.science.ru.nl/studiereis12/>

KvK: 41057429

Study Tour Committee 2012

Luc Depré, Chairman
Merijn Blaakmeer, Secretary
Onno van Dillen, Treasurer
Bart Borghans, Travel coordinator
Ralph Slijkerman, Travel coordinator
Mathilde Castelijns, Sponsor coordinator
Inès Penders, Sponsor coordinator

Printing

Copycenter The Print Nijmegen

Circulation: 60 copies



Lonza

Lonza Verviers is the European Service Center for Lonza Bioscience.

It is both a production and distribution site for custom and research media, with products for clinical cell therapy, molecular biology and endotoxin detection.

Its warehouse and distribution facilities serve as a European sales channel for life-science products manufactured at other Lonza Bioscience sites. It is also the European divisional headquarters for Finance, Administration, and Customer Service.



COPYCENTER THE PRINT

www.theprint.nl

service & doe-het-zelf

printen & kopiëren

inbinden & afwerken

grootformaat t/m A0

t-shirts & muismatjes

NIJMEGEN

Kelfkensbos 48
024-3240515
nijmegen@theprint.nl

TILBURG

Besterdring 99
013-5365447
tilburg@theprint.nl

MAANDAG TOT VRIJDAG OPEN VAN 10.00 TOT 18.00 UUR
DONDERDAG GEEN KOOPAVOND
ZATERDAG VAN 10.00 TOT 17.00 UUR

STUDY TOUR 2012
NORWAY AND SWEDEN

