PS News

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PLANT SURVIVAL
National Centre of Competence in Research

Newsletter of the National Centre of Competence in Research (NCCR)
Plant Survival in Natural and Agricultural Ecosystems

Editorial

A stepping-stone for young scientists

For young researchers, a stint at the NCCR *Plant Survival* is a unique opportunity to broaden ones scope of competences and to establish links with other scientists. This is made easy by the fact that NCCR's mission includes stimulating exchanges between different disciplines and different institutions. These are essential ingredients to follow an academic career.

Traditionally, postdoctoral researchers represent the driving force of research. These are young scientists who have recently defended their theses or finished a first postdoctoral position. Within the framework of the NCCR, as well as in other Swiss academic institutions, the duration of the contract generally lasts four years, which means a race against time for those in such a position.

It requires familiarizing oneself to the research topic proposed by the lab director, usually a professor, and to quickly get the research up and running. The researcher must also oversee students by giving courses or laboratory exercises. Furthermore, he or she may be asked to co-supervise a thesis (at the Master or Bachelor level). However, since it is not a permanent position, most if not all post-docs continue to search for a permanent job.

For French graduates, a popular job opportunity is that of *Maître de Conférence*. It has the advantage of providing stability along with the added responsibility of a research group. This opportunity presented itself to Arnaud Ameline and Jérôme Moreau from Martine Rahier's laboratory, who today work in Amiens and Dijon respectively, after having spent one year at the NCCR. A third postdoctoral fellow from the Laboratory of Animal Ecology and Entomology at Neuchâtel, who applied in Lille, jumped at another opportunity that is part of the French academic structure: that of ATER (*Attaché Temporaire à l'Enseignement et à la Recherche*. Limited to two years, this position was created to cover the lack of lecturers. Laurent Amsellem's bet paid off because one year after his arrival he was offered a position of *Maître de Conférence* that had recently been created at Lille.

Different country, different customs. Having come to Neuchâtel with a German grant to apply his talents under the direction of Ted Turlings, Michael Rostàs returned to his country of origin and is now at the University of Würzburg. Even though he traded his old job for a position of only three years, it represents an important step, since it will permit him to prepare an "Habilitation". In both Germany and the German-speaking part of Switzerland, this is a thesis that an experienced researcher defends before a jury. The "Habilitation" is an obligatory pre-requisite if one hopes to obtain a professorship in the German-speaking regions.

Of course, there are other reasons than just the professional career. Laurent Barnavon was part of Jean-Marc Neuhaus's team. Two years after starting his job in Neuchâtel he decided to return to France. An ATER position came up in Dijon and since that is where his partner and son live, he did not hesitate to rejoin his family. His decision perfectly well illustrates the tendency to marry one's professional and family life.

Igor Chlebny
NCCR *Plant Survival* Communication Officer
University of Neuchâtel

NCCR *Plant Survival* International Conference
March 31 - April 3, 2005 in Leysin

Last registration deadline : February 25, 2005
For more information: www.unine.ch/nccr/international/

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Summit Meeting

The NCCR *Plant Survival* International Conference will be held high atop the Swiss Alps in Leysin, from March 31st to April 3rd. Concluding the First Phase of the NCCR, it will give renowned scientists the opportunity to talk about their research concerning relationships between plants and their environment.

Coming from Europe, America and Oceania, specialists from the world over have accepted the invitation from the NCCR *Plant Survival*. Whether they are ecologists, plant physiologists or molecular biologists, their common passion is to better understand the interactions between plants and their environment. How do plants manage to survive despite adverse environmental conditions? How do they fight against pests and diseases? How do they make the most out of light energy? These are some of the questions that the invited speakers will address in Leysin.

The resistance to extreme environmental factors is one of the research areas of Robert Henry, professor at Southern Cross University in Australia. This interest led him to study domesticated fragrant rice varieties (jasmine and basmati) of which the genes have undergone a mutation compared to wild varieties. However, it happens that these genes are also associated with increased tolerance in the plant to drought and to high salt levels in the soil. From a historical point of view, it is ironic that the selection of this rice for purely olfactory reasons has resulted in its loss of precious survival qualities. Robert Henry's work is not limited to rice, though, grapevine, sugarcane, barley, wheat, sorghum and eucalyptus are also part of his research programme.

As for Anurag Agrawal, assistant professor at Cornell University in the USA, he is interested in the interactions between animals and plants, in their nature and evolution over time. One of his favourite subjects deals with the organisation of insect communities that feed on milkweed plants. These plants are considered to be poisonous: they contain powerful toxins called cardenolides that attack the heart. Their gummy latex would seemingly seal any herbivore's mouth shut upon the first bite. This doesn't prevent the *Asclepias* from being the food of choice for several insects, and moreover not one single crumb is wasted. The aphids drink a sap enriched by substances derived from photosynthesis; caterpillars and beetles chew on the leaves, which are also part of the flies' diet. Bugs feast on the seeds, weevils bore through the stem and eat the pith and the beetle larvae bore through the roots. Which strategies do these organisms employ in order to overcome the noxious effects of this food source? Anurag Agrawal is testing several hypotheses, such as the capacity of certain insects to sequester plant toxins. He is also studying the genetic composition that diminishes the toxicity of certain *Asclepias* thus rendering them edible.

Representing the third major part of the conference, Karen Halliday, lecturer at the University of Edinburgh in the UK, has specialised in the ability of plants to capture light. Light is an essential ingredient of photosynthesis and because of its frequent changes in energy and intensity it requires plants to constantly adapt. Groups of photoreceptors found in leaves and stems absorb the light providing the plant with information about day length, the presence of neighbouring plants and the degree of shade. As observed in *Arabidopsis thaliana*, these signals guide the growth and development of the plant in such a way as to maximise its chances of survival. Karen Halliday's research focuses on the identifying and defining the precise function of individual genes in the light signaling network. Since these studies involve factors that have an effect on plant form, flowering time and seed set, they will be beneficial to the horticultural and agricultural industries.

For more information concerning the international conference:
www.unine.ch/nccr/international

Carbon at the crossroads of sciences

Eric Verrecchia, professor of Geology at the University of Neuchâtel, is one of the initiators of the Biogeosciences Master's degree, a programme that is unique in Europe. As of April, he will begin an active collaboration with the NCCR *Plant Survival* and will lead one of the nine thematic groups of the Second Phase. Here is a portrait of a geologist whose research touches upon the carbon cycle.

We can easily imagine geology as focusing solely on the mineral world, as a stone-cold science, mining the rock, breaking pebbles or scrutinising crystals under the microscope. However, we tend to forget that geology includes the study of the soil that is brimming with activity. Between the mineral and the living, the exchanges are ongoing in what can be considered as a thin layer on the global scale since it measures a mere thirty meters in depth. It is this environment – the surfacial geology – that Eric Verrecchia has been exploring for the past twenty years and is continuing to do so today in his geodynamics of the biosphere laboratory, which includes defining phenomena that are found at the crossroads of geology, microbiology, and soil sciences. Along with Michel Aragno and Jean-Michel Gobat, professors from Neuchâtel working in the latter two disciplines, he has established a university course on Biogeosciences (BGS). To this day, there exists only two programmes of this type, both in Canada. The BGS Master's degree in Neuchâtel had a start in 2004 and has taken advantage of the three initiator's research topic, the Earth's epidermis.

So how does BGS differ from the currently popular postgraduate environmental studies? "The BGS concentrate on the study of chemical, physical and biological processes that occur across an extensive range of spatial and temporal scales", answers Eric Verrecchia. "The environmentalist adopts an engineer's approach, which stems from applied sciences and is essentially based on problems found at the human level. The BGS are the counterpart, the fundamental sciences."

More specifically, in terms of scientific research, this geologist has been concentrating on a problem that has long been bothering mycologists and botanists alike: the mystery of calcium oxalate. This salt, which contains carbon, is stored in the form of crystals in the cells of plants and fungi. As an example, for one type of ecosystem in the Ivory Coast, up to 10,000 tons of oxalate per year are produced!

It seems that calcium oxalate is involved in one of the key stages of the storage of carbon derived from atmospheric CO_2, a gas used by plants during photosynthesis. What is still unclear is by which means the majority of the carbon –in fact 95% of it– contained in the oxalate leaves the organisms that created it and ends up in the soil in the form of a carbonate, which can remain there for millions of years.

Recent experiments, carried out by Eric Verrecchia and his team in the Ivory Coast and in Cameroon, have shown that the carbon stored in the soil via the formation of oxalate in tropical forests is equivalent to the quantity of carbon contained in all of the CO_2 released by volcanoes. This is enormous! Therefore, when speaking of CO_2 one also speaks of climate changes; hence the importance of research on oxalate. It is not surprising then, that their published results fresh off the printing press have been met with an avalanche of mail sent from several well-known North American universities. They're interested in the verification of the conclusions in the Neuchâtelois researchers' article, their applicability to North America's vast semi-arid areas and finally in the processes that transform plant matter into crystals.

Another aspect that puts Neuchâtel at the head of oxalate research is of historical importance. There exists a group of microorganisms that feed on oxalate and transform it to carbonate. These are the oxalotrophic bacteria that are found in the soil. The first to have discovered their fundamental role in the carbon cycle is none other than one of Eric Verrecchia's colleagues: Michel Aragno. His article dating from 1980 and published in the *Bulletin neuchâtelois des sciences naturelles* is still regularly quoted in top journals.

News from the labs

Vietnamese delegation

J.-A. Possa/FNS

A delegation from the Vietnamese Ministry of Science and Technology (MOST) visited the head office of NCCR *Plant Survival* at the University of Neuchâtel last October 7th. During their visit, which was guided by a representative from the Swiss National Science Foundation, the delegation aimed to get insight into how Swiss NCCRs operate, their objectives being to set up similar programmes in Vietnam.

The members of NCCR's MCU (Management and Coordination Unit) spent the afternoon with Mrs. Nghiem Thi Minh Hoa, Officer of Department Planning and Finance of MOST along with three colleagues: Mr. Nguyen Quan, Director of Personnel and Organization Department, Mr. To Dinh Huyen, Vice Director of the Social and Natural Sciences Department, and Mr. Dang Duy Thinh, Deputy Director of the National Institute for Science & Technology Policy and Strategy Studies.

After having listened a presentation by Martine Rahier on NCCR's structure, the delegates asked questions concerning the knowledge and technology transfer, the IT-tools of the NCCR, the organisational aspect of the Graduate School, and the communication methods with the media. The discussion ended with a visit of the university's plant biochemistry laboratory.

Integrated production: users guide

Almost 80% of the current Swiss arboriculture and viticulture meet integrated production (IP) criteria. A large majority of apples, pears and grapes harvested in our country stem from this type of production. But what does this label signify and what are the practical implications. A course from the Graduate course will be devoted to this subject on February 10th and 11th in Neuchâtel. The criteria are not simply limited to controlling plant pest and diseases by using biological control methods. Those that wish to practice IP methods must also choose the proper land, ensuring that the climate is appropriate for the plant varieties selected and to always look to alternative measures when dealing with plant problems such as a higher level of tolerance to certain attacks if the fruits are not affected and using a treatment only when the symptoms require it.

The course is multidisciplinary containing scientific, technical and legal aspects. Pest control using both beneficial insects and insecticides will be discussed. Induced disease resistance in plants and using sexual pheromones to prevent insect pests form reproducing will also be covered. Case studies on grapevine and greenhouse production will be presented as well as the role of genetically modified plants in IP.

Beneficial cows

A cow grazes, tramples and deposits its dung and urine. Totally normal, wouldn't you agree? But imagine for one second being the poor plant at the receiving end of all this! Despite all of that, the plants come out of it in pretty good shape. A biologist from the University of Neuchâtel has demonstrated that in fact the cows' actions encourage plants to diversify. The study, financed by the Swiss National Science Foundation and with the support of the NCCR, was completed at the end of 2004.

Florian Kohler from Neuchâtel who is also part of the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), conducted his studies on two sites situated in the Neuchâtel and Bern Jura mountains. He noticed that in plots where there was no disturbance from cows, approximately 8 species disappear in a two-year period, in other words one third of the plant biodiversity. "Grazing, trampling and the deposit of excrements create a micro-habitat favourable to very diverse plants", explains the biologist. Hence, in the small

depressions caused by the cow's hoof, so-called pioneer plants will inhabit that area. "These plants are not very well competitive and therefore have found an ideal environment for their growth and development", adds the scientist.

J.-D. Gallanda/UniNE

Cattle cause disruptions that are not entirely negative for plants since they enable a large number of plant species to coexist.

With this evolution being too confined to observe, Florian Kohler reproduced the effects of cattle on a larger scale within one of the sites, protected by a fence. A lawn mower was used in place of the ruminants' teeth to simulate grazing and fertilizer replaced the cow dung. As for the trampling, the biologist himself took care of squishing the innocent plants with his boots.

The pasture woodlands that cows help to enrich in plant species is representative of a typical landscape found in the Jura. Made up of a mosaic of trees, shrubs and meadows, it does however pose a problem at the junction where the agricultural, forest and tourist industries meet.

Colette Gremaud (Press and Communication Office - UniNE)

Education in Senegal

The NCCR *Plant Survival* is one of the partners of MICROTROP, a training programme that will be held from April 25th to May 28th 2005 at the University of Dakar (Senegal) dealing with the links between microbial diversity and environmental deregulation. Demonstrating NCCR's commitment to encourage the mobility of young researchers, two students from the Graduate School have registered and will benefit from a travel grant to attend the course.

The objectives of the organisers is to instruct young scientists on the study of soil microbial communities using an ecological approach and to initiate the participants to the modern techniques of molecular ecology in order to help them tackle current environmental problems such as pollution or sustainable soil management. The final goal is to establish a permanent network between the microbial biology researchers from northern and southern countries.

The lecturers will be teachers and researchers from European and African universities and research institutions which will include Michel Aragno, Microbiology Professor at the University of Neuchâtel and who is also a member of the NCCR *Plant Survival*.

For more information: **www.ird.sn/microtrop/**

Open science

The Faculty of Sciences of Neuchâtel will open its doors on March 11th and 12th. The first day will be reserved for the canton's high school students. However, at the first signs of dusk and up until 10pm the general public will be invited to join the activities located on the hill of the Mail and on the banks of the lake where physics and microtechnology will be showcased. For those who are not night owls, or who are interested in learning more, the festivities will continue the following day.

Scientists from the NCCR *Plant Survival* will have an active part in setting up these events and will offer venues in the areas of botany, ecology and parasitology. As for other Neuchâtel's Alma Mater members, they will show examples of research in mathematics, physics, microtechnology, chemistry, geology, hydrogeology and computer science.

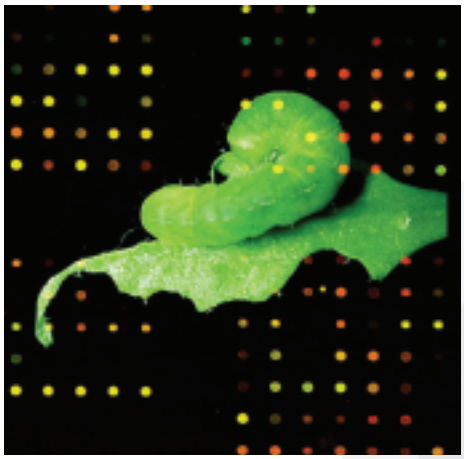
These two days are part of the 'Quinzaine de la Science' from March 7th to the 18th, a two weeks period of promoting science for the public. The programme includes conferences dealing with subjects that are both fascinating and varied. Can we predict earthquakes and tsunamis? How does the Google search tool actually work? What is the real cause for the extinction of dinosaurs? There will also be a presentation by a mathematician on the Dan Brown's best-seller *The Da Vinci Code*, without forgetting laboratory visits as well.

Graduate School

Microarrays for detecting genes

By no means should genomics be ignored. This could be the maxim for the course that is held in January and February 2005 in Neuchâtel dealing with the utilisation and the functioning of microarrays.

Microarrays, an essential tool of modern genomics, are used to determine the genes responsible for expressing certain physical or physiological characteristics of any organism: bacteria, yeasts, fungi, plants or animals. In plant biology alone, they could provide answers to the following questions. Which genes are involved in grapevine resistance to pathogens? Which ones assist in grape ripening? Or which ones help plants to defend themselves against herbivorous caterpillars? However, this only scratches the surface of research possibilities, since the area that this can be applied to is so vast: microarrays are used extensively, even in human medicine such as for the genetic characterisation of tumours, which improves the diagnosis of breast cancer and hence a more precise treatment can be applied.



An attack by an herbivorous caterpillar modifies the gene expression of a plant, which can be seen using microarrays (bright dots).

"Compared to the conventional gene analysis techniques, microarrays provide a global analysis of a whole genome, or about 40,000 genes, along with all the richness of information that this implies", points out Philippe Reymond, Tenured Senior Lecturer and Researcher at the University of Lausanne, who will be one of the lecturers for the proposed courses of the Graduate School of the NCCR *Plant Survival*. This technology was perfected at Stanford University (USA) in 1995, and the laboratory where Philippe Reymond works was the first in Switzerland in 1997 to express interest in it.

So how does it work?

The genes or parts of genes are either printed on glass slides with the help of a robot, or synthesized on a similar surface, a technique developed by the firm Affymetrix. The course focuses on how both methods work. Each gene on a chip occupies a microscopic space of 20 to 100 microns, which makes it possible to place a whole genome on a surface of a few square centimetres. The goal is to compare the activity of the genome (transcription) of two biological samples. One could, for example, apply this method to the genetic analysis of two individuals exposed to an allergen, where the first person would be allergic but not the other. Thanks to microarrays, which enables one to read the genome in the form of small, illuminated dots, it is possible to know how many and which genes are active (or inactive) in each of the individuals tested. The list of possible applications and to the organisms that microrrays can be applied to is infinite.

Equivalent methods

Microarrays and the Affymetrix chips can be used to analyse the genetic expression in any organism. With Affymetrix, it is necessary to know the whole of the genome of the species in question, which is not the case for microarrays. Nevertheless, the two methods are equivalent in terms of sensitivity, efficiency and end-results. The main difference is that Affymetrix chips are commercialised (but very expensive) and can only be produced in specialised laboratories. On the other hand, microarray technology printed robotically can be installed in research laboratories. It remains that investing in such a robot and acquiring the know-how are obstacles to overcome when considering this set up. In the long run, however, it is definitely more economical. In other words, microarrays on demand containing either a whole genome or groups of desired genes can be fabricated at a lesser cost.

The course in Neuchâtel is given by six lecturers and consists of three modules of two days each. The first is devoted to the technical aspect of the printed chips and the Affymetrix chips, as well as examples of its use in plant research. The two others are dealing with statistical methods for analysing the results.

Insects prefer their tobacco nicotine free

According to the Max Planck Institute (MPI) in Jena (Germany), moth caterpillars that feed on tobacco leaves show a preference for tobacco varieties with low to zero nicotine content. Just like the interdisciplinary aspect that exists at the NCCR *Plant Survival*, the molecular ecology laboratory at the MPI, responsible for that discovery, developed a research approach mixing entomology, chemistry and molecular biology.

Danny and André Kessler/ MPI for Chemical Ecology/Jena

Tobacco hornworms that feed on varieties with high nicotine content tend to grow more slowly.

The tobacco, *Nicotiana attenuata*, is a favourite of the night moth *Manduca sexta*, called the sphinx moth. Their larvae, called tobacco hornworms, adore the leaves of the Solanaceae family member. This is in large part due to their resistance to nicotine, a substance known to be highly toxic to animals, and particularly to insects. Nicotine disrupts the transmission of signals between neurons, which can prove fatal depending on the organisms that fall victim to it. It is not surprising then that it was one of the first insecticides used in agriculture.

Nevertheless, some insects such as the sphinx moth have become nicotine-adapted and can tolerate doses that would be lethal to other organisms. However, this adaptation comes at a price, since the caterpillars that feed on varieties with high nicotine content tend to grow more slowly. Also, when given the choice, the caterpillars clearly prefer plants with low nicotine content. This is the first time that this study has been performed in a natural environment.

Even though the results seem logical, the experiment itself was not so easy to carry out, because it required knowledge in genetics, chemistry and ecology. First of all, a variety of tobacco needed to be created of which the gene responsible for nicotine production was silenced. The chemical aspect was used for measuring the nicotine content: in the genetically modified variety, the toxic substance was reduced by 95% compared to the wild variety. The ecological approach consisted of determining the influence that nicotine has on organisms found in the plant's immediate environment. The outcome? The tobacco plants with low nicotine content were not only devoured by the sphinx moth but also by the spotted cucumber beetle *Diabrotica undecimpunctata*. They lost up to three times more leaves than their wild relatives when attacked by the herbivorous caterpillar *Spodoptera exigua* (beet armyworm) and by the grasshoppers *Trimerotropis*.

Partners right from the start

Just like Martine Rahier, Director of the NCCR *Plant Survival* and Professor of Ecology at the University of Neuchâtel, and her group, the team of the molecular ecology laboratory at the Max Planck Institute is interested in plant-insect relationships. Both are using interdisciplinary approaches to carry out their research. Professor Ian Baldwin, head of the German laboratory, is also member of the Advisory Board of the NCCR *Plant Survival*, a panel of experts who periodically offer scientific advice.

Moreover, the ties between the NCCR and the Max Planck Institute also include the transfer of researchers. Cris Kuhlemeier, Deputy Director of the NCCR and Plant Biology Professor at the University of Bern, spent his sabbatical leave in Ian Baldwin's laboratory. On the other hand, Matthias Held who did his PhD thesis under the supervision of Ian Baldwin is currently doing a postdoc in Martine Rahier's laboratory. This past autumn he published an article dealing with the use of microarrays (see p. 6) to study interactions between plants and herbivorous insects. His work could be used to focus on genes that control nicotine production in tobacco (see above). It also concerns other genes that are linked to plants' chemical response mechanisms when attacked by insects. Such is the case with the PI gene, which codes for the proteinase inhibitors. These compounds reduce the digestibility of plant tissues for herbivorous insects and serve as an efficient plant defence mechanism.

Upcoming events

Special NCCR Event

NCCR *Plant Survival* International Conference
March 31 - April 3, 2005 in Leysin (Switzerland)

Arrival on March 31, 2005
Lectures April 1-2, 2005
Facultative excursion on April 3, 2005

Last registration deadline: February 25, 2005
For more information: www.unine.ch/nccr/international/

Graduate School courses

Microarrays - Bioinformatics: 3 modules

Philippe Reymond, University of Lausanne (Switzerland)
Otto Hagenbuchle, University of Lausanne (Switzerland)
Philip Zimmermann, ETHZ (Switzerland)
Jean-Pierre Renou, INRA, Evry (France)
Darlene Goldstein, EPFL (Switzerland)
Mauro Delorenzi, SIB/ISREC (Switzerland)
January 14, 20-21, 27-28, February 4, 2005

Integrated Management of Pests and Diseases

Pierre-Joseph Charmillot, Agroscope RAC Changins, Switzerland
The Use of Insecticides and Pheromones in IPM of Insects
Yigal Elad, The Volcani Center, Israel
Integrated Management of Diseases in Greenhouses
Padruot M. Fried, Agroscope FAL Reckenholz, Switzerland
Principles of Integrated Pest Management (IPM) and Integrated Production (IP)
François Laurens, INRA Angers, France
Resistant Plants in IPM of Apple Diseases
Joop C. van Lenteren, University of Wageningen, The Netherlands
Integrated Management of Insect Pests in Glasshouse Crops
Jörg Romeis, Agroscope FAL Reckenholz, Switzerland
Genetically Modified Plants as a New Tool for IPM
Olivier Viret, Agroscope RAC Changins, Switzerland
Integrated Pest and Disease Management in Viticulture

February 10-11, 2005

Deontology and Ethics in Science
March 18, 2005

How to Make Scientific Presentations and Posters Interesting?

Prof. Jeremy N. McNeil, Department of Biology, University of Western Ontario, Canada
April 28-29, 2005

Second Tri-National Arabidopsis Meeting
Joint workshop with the *Troisième Cycle romand en sciences biologiques.* Registration available in January 2005.
August 24-27, 2005

Information and registration: www.unine.ch/nccr/
then click on Education>Graduate School>Courses

NCCR events

Review Panel Site Visit
January 31-February 1, 2005
University of Neuchâtel

Other events

La Quinzaine de la Science

Faculty of Sciences, Neuchâtel
March 7-18, 2005
Series of conferences to the general public
Open house on March 11 evening, and March 12

Location: UniMail and lake side

For more information: www.unine.ch/sciences

New press releases

Small wasps and leaf litter for the protection of horse chestnut trees (16.11.2004)

Why do plants grow towards the light? (26.10.2004)

For more information: www.unine.ch/nccr then click on Press> Press releases

PS News

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