The Magazine from Carl Zeiss

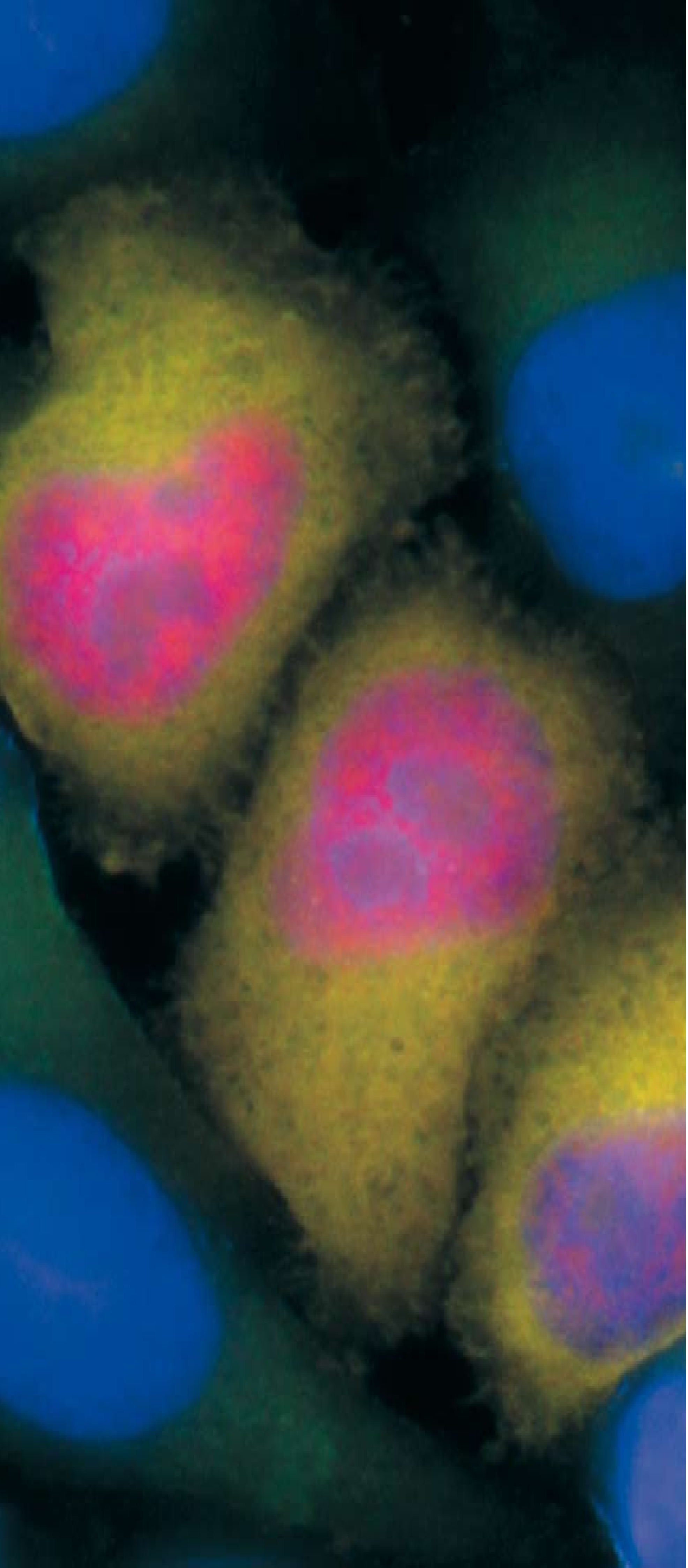
Issue 18
9/2007

Innovation

Innovations: Don’t Leave Innovation to Chance

Insights: Neanderthals under the Microscope

Image Qualities: Bringing Scent to the Big Screen



Fluorescence microscope image: Triple fluorochromized cell culture specimens. The fluorescence dyes are excited using the revolutionary Colibri fluorescence illumination system which is based on the latest LED technology and provides up to ten different wavelengths with precisely defined spectrums. (Specimen: Center for Biochemistry and Molecular Cell Biology, Biochemistry 1 Department, Georg August University Göttingen, Germany)

Editorial

Dear Readers,

Excellence is our unwavering aspiration at Carl Zeiss.
We strive to offer our customers the best products and services, and thus make a vital contribution to their success.

Innovation *is the key factor in this excellence at Carl Zeiss, where innovation has been a way of life for more than 160 years; you might even say it is in our genes.*

Carl Zeiss has always been known for its spirit of discovery and scientific progress. Increasingly complex technologies and processes are constantly required to advance our highly developed products and procedures.

Therefore, we rely on international networks and alliances to remain a global leader. Our researchers and developers, and our application and marketing specialists maintain close contacts with customers, suppliers and the best scientists in the world to integrate the latest trends, insights and research results into our products and services: for competitive advantages and for your benefit. Innovation *is one of the tools we use to maintain contact with you, our customers and partners.*

The editors would like to know what you think of the new Innovation.

Enjoy reading!

Best wishes

Dr. Dieter Kurz
President and CEO of Carl Zeiss AG

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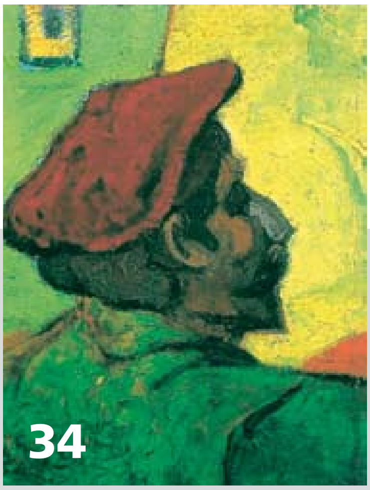
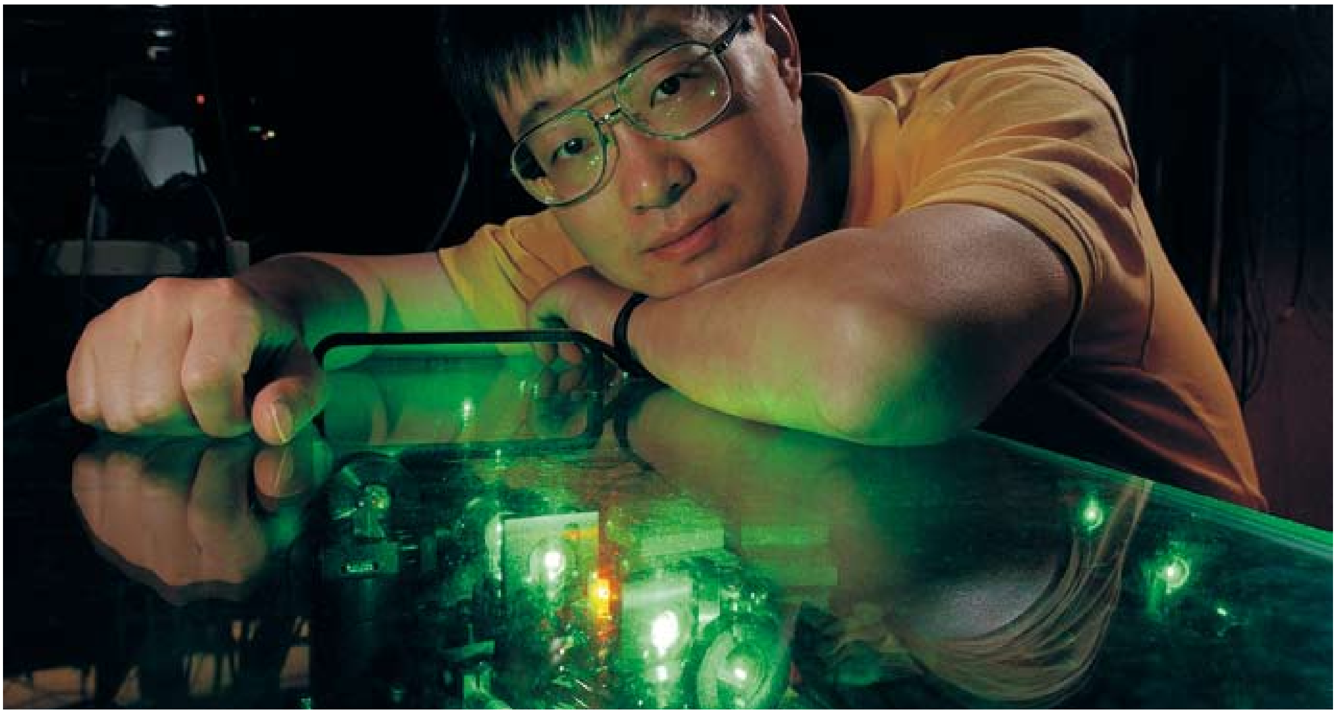
At Your Service



How did Vincent van Gogh paint? State-of-the-art electron microscopes reveal his secrets.

"Perfume" was filmed with a Master Zoom, the high-performance lens from Carl Zeiss.



Seconds are small eternities to him: Carl Zeiss Research Award Winner, Jun Ye.

Counting Seconds

Jun Ye Receives 2007 Carl Zeiss Research Award for New Atomic Clock

Why do clocks have to be accurate down to the atto-second? Surely not for reasons of punctuality. No one meets at seven on the dot according to a normal watch, and even those waiting for a train do not need to be that punctual – trains are never on time as it is. Why then a need for attoseconds? In the time it takes to say "twenty-one," a billion times a billion attoseconds have already passed. Why then must clocks measure such unimaginably small periods of time? Highly accurate clocks are not just a quirk of physicists. For example, they are used for navigation at great distances such as determining the position of the Voyager 1 probe that has been underway for more than 30 years and has already left our solar system. Atto-seconds are also used to calculate the orbits of planets. Atomic clocks have been used to set our watches since 1967. They are counting machines. The faster the atoms decay, the faster you have to count them. This occurs fastest optically. John Hall and Theodor Hänsch did not win the 2005 Nobel Prize in Physics for their laser-based precision spectroscopy without good reason. 40-year old American physicist and colleague of John Hall at the University of Colorado Jun Ye enhanced the measuring technology of the two Nobel laureates and catapulted himself to the global summit in the development of frequency-stabilized lasers and the measuring technology based on it. His atomic clock uses the optical properties of strontium atoms and is more precise than the cesium-based atomic clock from 1967. His work earned him the 2007 Carl Zeiss Research Award.

Teflon®: More Than Meets the Eye

Coating excellence now also for eyeglass lenses

Teflon® is one of the best-known brands in the world. The name always appears whenever the subject turns to high-quality coatings. This synthetic material with the extremely smooth and chemically stabile properties has conquered a wide swath of daily life since its discovery in 1938. Whether the electronics, chemistry and automotive industries or at home – the range of uses for Teflon®, a DuPont brand, has been continually increasing since the 1950s.

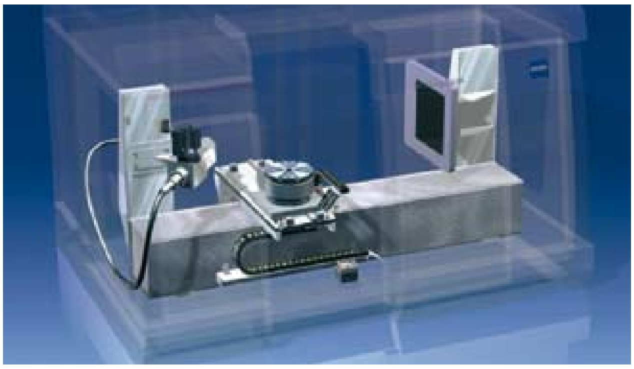
Teflon® stands for a simple message: protection, comfort and long life. For this reason, Teflon® was added as a high-end coating for eyeglass lenses from Carl Zeiss Vision: Teflon® easycare. The Teflon-coated lenses speak for themselves: they do not get dirty as quickly as their surface repels water and oil. They can be cleaned quickly and easily and feature antistatic properties. The highly effective broadband antireflective coating ensures clear vision. Two years after Carl Zeiss acquired US eyeglass lens manufacturer SOLA International and merged it with its own Eyeglass Division to form Carl Zeiss Vision, the prospect of market leadership is better than ever. The new company, whose lenses are worn by 200 million people around the globe, is now the world number 2 and aims to become the market leader in Germany by 2010 at the latest – also thanks to Teflon®.

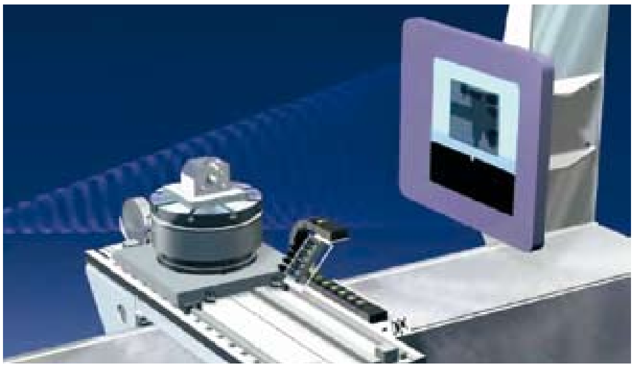
Water simply beads off: eyeglass lenses coated with Teflon®.

Swiss Passion

Metris AG impressed by precision and efficiency of METROTOM

The small alpine country of Switzerland is known for its snow-capped mountains, deep-blue lakes and a population that rarely gets excited. However, this is precisely what happened to Roger Eggenberger when he experienced the *METROTOM*® 1500 from Carl Zeiss. For the President of Metris AG in St. Gallen, Switzerland, this machine marks the dawn of a new era in 3D metrology. "*METROTOM* enables us to access a new customer segment which we were unable to serve with this level of precision and efficiency in the past," says Eggenberger. This new measuring technology ideally complements the contact and optical measuring scenario of his company: 100 percent information is delivered within a fraction of the time usually needed. *METROTOM* is the fusion of traditional metrology and industrial computer tomography. It uses x-rays for the non-destructive measurement of the interior and exterior of complex and small workpieces, creating a three-dimensional image in the process. The details of the test piece appear as a 2D image in varying intensity depending on the geometry and absorption properties. A spatial image is generated when the object turns around its own axis on a rotary table. While this is happening, the data is converted to provide a 3D volume model using *Calypso* – a software package from the development lab at Carl Zeiss.





METROTOM uses x-rays for the non-destructive measurement of complex workpieces.

Science and Society

Jena is the German City of Science in 2008 and its famous university is celebrating its 450th anniversary

Combining tradition and the future: the Friedrich Schiller University in Jena.

Six words sum it up: "Made in Jena – Growth and Knowledge". Starting in January, the city on the Saale River will proudly deck itself with this motto for twelve months. Jena is the German "City of Science" in 2008. Another major event is also taking place this year: the Friedrich Schiller University in Jena, in which a total of over 20,000 students are enrolled, is celebrating its 450th anniversary. The initiatives sponsored by a consortium of German industries to promote science and higher education, which are also backed by the German government, are aimed at intensifying the dialog between science and society. The application submitted by the 100,000-strong city, in which the first Zeiss workshop was founded over 160 years ago, perfectly fits the bill. Jena soared above the rest through "its originality and passion for innovation," was how jury member Joachim Treusch summed up the final decision. Treusch, physicist and President of the Jacobs University in Bremen, commented: "The winner is the city of the distinguished triumvirate: Zeiss, Abbe, Schott."

Dr. Ulrich Simon, President of Carl Zeiss MicroImaging GmbH, reported that the winning city did its utmost to ensure that the traditional cooperation between industry and science was not only effectively managed, but also actively lived by its inhabitants. He represented Jena industry at the meeting of the consortium of German industries for the promotion of science and higher education in Braunschweig: "Being an active partner of the alliance for science and growth corresponds precisely to the corporate philosophy of Carl Zeiss." In this spirit, the four Presidents of the Carl Zeiss companies in Jena – Carl Zeiss Jena GmbH, Carl Zeiss Meditec AG, Carl Zeiss MicroImaging GmbH and Carl Zeiss SMS GmbH – are lending their support to the board of trustees appointed for the 2008 City of Science.

Jena ablaze with light and resonant with sound during the event held to herald the launch of the City of Science.

High-power Chips

More than 450 million euros for new factory in Oberkochen

Practically everyone is aware of the health hazards associated with potato chips. Microchips on the other hand are industry favorites, particularly microtechnology. Understandably, too. After all, they open up additional possibilities in the research and development of new products and services. Carl Zeiss SMT AG is playing its part in this trend. The company's new *Starlith® 1900i* lens system is paving the way for the next generation of microchips – for example, applications that require a lot of memory such as extremely high-resolution digital photography with cell phones. Carl Zeiss SMT AG built the world's most advanced development and production center for lithography optics for the development and production of new microchips. Where: Oberkochen. Carl Zeiss SMT has invested more than 450 million euros in the new factory since the ground-breaking ceremony in 2000, including approximately 150 million euros in buildings and infrastructure, as well as more than 300 million euros in production and measuring facilities. Approximately 1,400 employees work in the new factory. More than 45,000 square meters of the most advanced floor space for production, development and organization have been created, a large percentage as clean rooms, in order to meet the demanding production requirements for the precision optics of Carl Zeiss SMT. The factory is already being expanded as scheduled. The new building provides space for an additional 140 jobs and several meeting rooms.

Large numbers of visitors tour the new factory.

The ultimate in technical excellence: the market leader for lithography systems makes its products in the new, high-tech factory.

A demo center with leading edge electron microscopes is available to customers and partners.

Zeiss Ikon – A Love Story

Continues

Analog photography lives on only because famous photographers such as Jim Rakete and Arno Fischer swear by it. This type of photography, particularly for still shots, takes you back to the roots of photography regardless of all the discussions about the aesthetic aspects involved. Analog images radiate warmth and communicate the uniqueness of the moment.

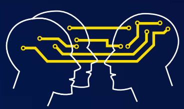
Photos by Hans-Joachim Miesner

Unique Moments

There are also photo enthusiasts in the 21st century who prefer to work with film-based 35 mm rangefinder camera systems. One of them is Hans-Joachim Miesner, an employee at Carl Zeiss Surgical GmbH. In addition to a passion for his job, he is also fascinated by the people and landscapes of the northern German coastal regions. His tool of choice is the new *ZEISS Ikon.* And with good reason, too: the camera and its *ZM bayonet lens* offer everything he needs to indulge his passion. The analog camera stands out not only because of its technical aspects, but also in its use: a classic design united with a simple operating concept. Automatic or manual TTL exposure metering as well as an AE-lock function provide complete control even in difficult situations. Exposure corrections are thus simple and swift, virtually intuitive.

For decades, ZEISS Ikon was the best and most important company in the German optical industry. Zeiss Ikon AG was founded in 1926 through the merger of four manufacturers of optical instruments. Their legendary roots extend throughout the history of photography. The “Ikon” in the name is the result of the combination of “Ica” and “Contessa-Nettel,” almost identical to “Eikon,” the Greek word for image. An image is the place where photographers live out their passion. *The ZEISS Ikon* camera is the continuation of a great love story.

Some ideas strike like lightening. Some are good, some extremely good. In science, the best ideas are often those whose result cannot be predicted. Whatever it may be: an outstanding idea must always meet certain criteria. First, it must be something you cannot let go of. Second, it triggers lively discussions. Third, it can be successfully implemented to ultimately mature into an innovation.



Don’t Leave Innovati

On global markets, ideas as the basis for innovative products are increasingly becoming decisive competitive factors. This is reason enough for Carl Zeiss to facilitate ideas, specifically manage and promote innovations – both in global research networks and collaborations, as well as within the company. The best ideas are always the result of teamwork.

Text by Simone Urban and Thomas Nordiek

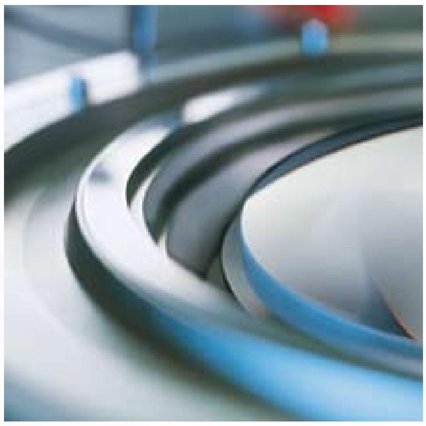
on to Chance

Innovation Cycles are Becoming Shorter

Understanding the unknown. Innovations have heavily influenced mankind since the beginning of time. They can inspire as well as unsettle. There are two sides to the story – confidence and skepticism. Experience shows that new inventions change life as we know it, and not always for the better. In order to overcome a fear of the unknown, you have to understand it and view its implementation critically – particularly in this age of the digital revolution. Whereas single developments were separated by entire generations in the past, the gap nowadays is often only several years. If you want progress, you must be able to keep up with the fast pace. This also includes the courage to ask questions, but also be open to new developments.

The chip makes it possible. Hardly any other branch exhibits the speed of the digital age more clearly than information technology. Dr. Hermann Gerlinger, President and CEO of Carl Zeiss SMT AG and Member of the Executive Board at parent Carl Zeiss AG, has experienced this first hand. After all, Carl Zeiss SMT is one of the world's leading system suppliers for the semiconductor industry, a highly dynamic sector inundated with a steady flow of information in which the continuous optimization of value chains within changing global conditions is part of everyday life. Today, it is possible to transport data at unparalleled speeds and at very low costs. Goods are exchanged around the world without any major trade restrictions. At the same time, high-quality research and production capacities exist in industrializing countries. Furthermore, the global exchange of knowledge occurs much faster today than just a few years ago. This all leads to ever shorter innovation cycles. Semiconductor technology is a prime example of this. While the lifespan of a microchip in the 1980s was eight years, today it is often six to nine months.

Consequently, the processes and workflows in all companies must become even faster. This is also particularly true for a high-tech company such as Carl Zeiss that must determine which parts of the value chain will be performed internally and which parts can be given to external specialists. The location of these specialists and the costs of their services also play a vital role.



Lens element of a lithography lens in its mounting ring.

Pages 14/15:
Excerpt from a display of high-power LEDs (Light Emitting Diodes) with which Carl Zeiss is blazing new trails in fluorescence microscopy – in the research of living cells, for example.

A Starlith® lithography lens shortly before the alignment process.

Moore's bold prediction. The fast-paced rate of innovation in semiconductor technology follows Moore's Law, named after Gordon Moore.

> *"It is important to find the right balance between doing it yourself and buying from the outside without ever losing sight of the customer's needs."*
>
> *Dr. Hermann Gerlinger*

In the 1960s, the cofounder of chip manufacturer Intel predicted that the complexity of microchips, i. e. the number of transistors on a chip would double every 18 to 24 months with minimal component costs. In general, the finer the semiconductor structures, the higher the computing capacity and speed of the chips.

Maintaining pace with rapid growth. Even if the gap today is closer to 24 months than 18, Moore's bold prediction is still valid. This is particularly true for the core competency

The details

Innovation – Origin and Meaning

Put simply, innovation means improvement and modernization. However, it is not the newness alone that makes an innovation. The semantic element of the word innovation is also the idea and its creative implementation which is indicated by the Latin root innovatio, meaning "something new."

Augustinus (354-430 A.D.) interpreted innovatio *as change and modernization, Shakespeare viewed the "innouator" as a person who brings about political change and Luther translated* innovare *as "to make new." The term innovation only became widespread in Germany through its usage by Joseph Alois Schumpeter (1883–1950). Until then, people spoke of "novelties" that primarily referred to technical areas.*

Continued on page 19

Unending pool of ideas and vibrant life in the up-and-coming metropolis of Shanghai.

of Carl Zeiss SMT: the development of lithography lenses for the wafer scanners used in microchip fabrication. As the heart of the scanner, the lens transfers the structures of what will later be the semiconductor components from a mask to the wafer, a photoresist-coated silicon disk. The more circuits transferred, the more precise the lithography lenses must be. Therefore, Carl Zeiss SMT is constantly working to improve its products. For example, the *Starlith® 1150* developed five years ago was only able to image structures down to 90 nanometers. The current *Starlith® 1900i* lens generation permits structure widths of only 40 nanometers.

> *"As a supplier of high-tech production and measuring machines to the semiconductor industry, this speed is nothing new to Carl Zeiss."*
>
> *Dr. Hermann Gerlinger*

Even known phenomena offer innovative potential. The 2006 Innovation Award of German Industry presented for the "*Starlith® 1700i* – immersion optics for chip fabrication" project verifies that Carl Zeiss is setting new standards with its lithography systems. For the *Starlith® 1700i* lens, Carl Zeiss SMT developed a technology that uses a proven optical method: immersion. A new optical design incorporating lens elements and mirrors, combined with a film of water between the lens and the wafer led to an almost 30 percent increase in resolution and therefore the generation of the smallest possible structures on the microchips."

How innovations get their wings. Innovations must not be left to chance. For this reason, Carl Zeiss relies on a targeted innovation management system – international research networks, detailed market studies, a structured idea management system and the systematic measurement of the success of innovations.

"Our task is to identify up-and-coming technologies and trends in China that are relevant to Carl Zeiss and then assess possible cooperation ventures."

Dr. Chun Shi Gu

Exchanging knowledge around the globe. The transfer of know-how at Carl Zeiss is a key driver of innovations. The company therefore relies on an international team of engineers and scientists to bundle skills and technologies from around the world. A prime example is the development of Optical Coherence Tomography (OCT) which provides contact-free, high-resolution 3D images of ocular tissues for the diagnosis and management of eye disease.

The world's first commercial product based on OCT technology was launched by Carl Zeiss in 1996 as part of a partnership between scientists at Carl Zeiss Meditec and the Massachusetts Institute of Technology. While this first product paved the way scientifically, worldwide acceptance of OCT into the standard of care came with the introduction of the second generation of the Stratus OCT™ system five years later. Today, with thousands of systems in use around the world, Stratus OCT™ is well established as a global standard for the diagnosis and follow-up care of retinal diseases.

The introduction of the Visante™ OCT system also makes non-contact optical coherence tomography available for the anterior segment of the eye. Today, OCT is being enhanced in cooperation with the University of Cardiff in Wales, UK, and the École Polytechnique Fédérale in Lausanne, Switzerland. All partners are striving to tap into the additional innovation potential of this technology.

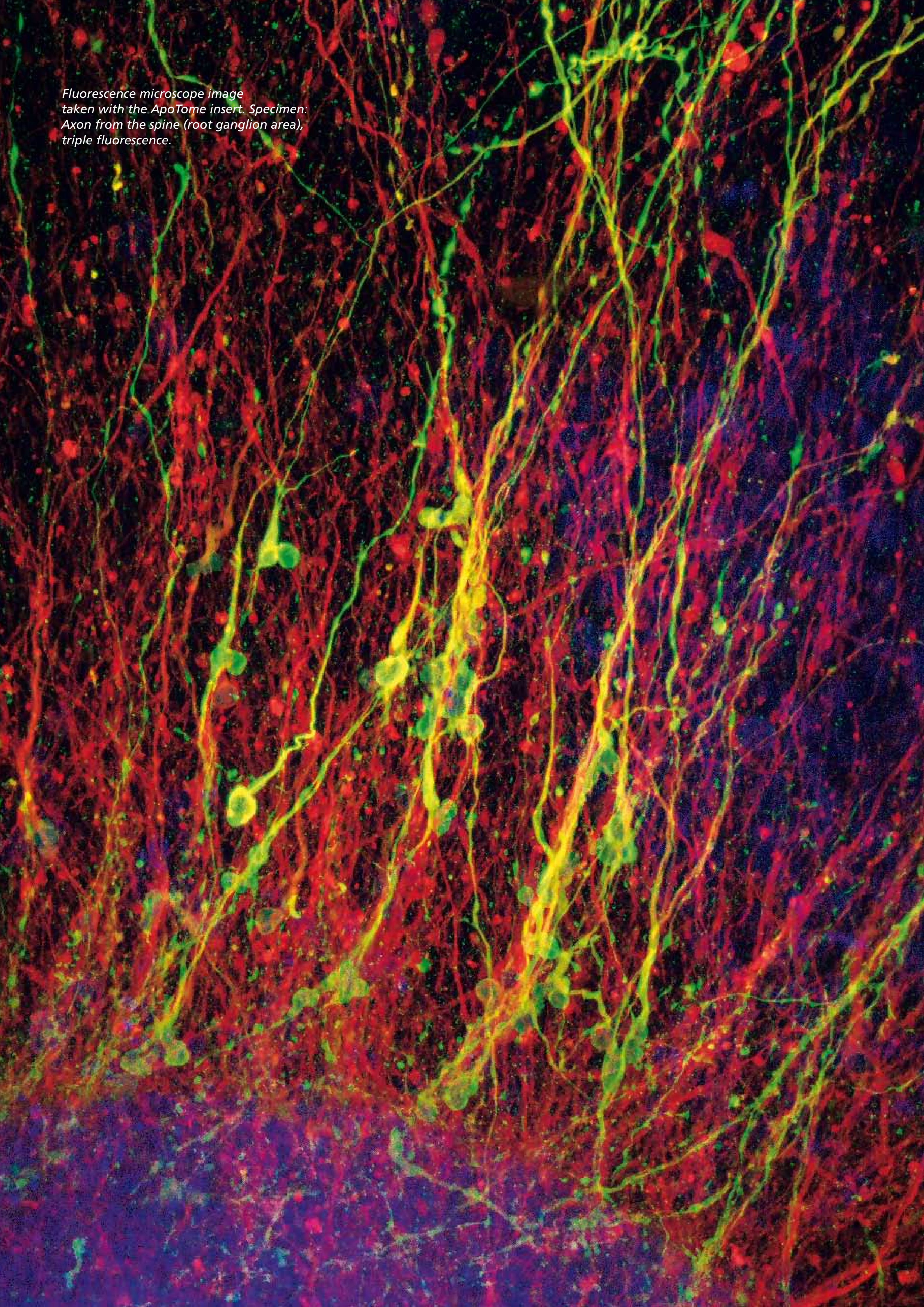
Targeted product development. The world's first commercial product based on OCT technology was launched in 1996 as part of a partnership between scientists at Carl Zeiss Meditec and the Massachusetts Institute of Technology in Boston. With the *Stratus OCT™* diagnostic system, the company es-

Ensuring the exchange of knowledge between China and Germany: Dr. Chun Shi Gu (left, China) and Dr. Hexin Wang (Germany).

The details

Innovation – Origin and Meaning

Schumpeter introduced innovation to the world of commerce and industry in 1939. According to his definition, innovation is the "implementation of new combinations" unlike invention which is defined as "the creation of something new." Schumpeter sees innovations as the new goods and production processes that triumph over older methods and squeeze them from the market.
As he sees it, the dynamic and creative entrepreneur is the motor behind it all.



Fluorescence microscope image taken with the ApoTome insert. Specimen: Axon from the spine (root ganglion area), triple fluorescence.

tablished a global standard for the diagnosis and follow-up care of retinal diseases. The introduction of the *Visante*™ *OCT* system also makes non-contact, optical coherence tomography available for the anterior segment of the eye. Today, OCT is being enhanced in cooperation with the University of Cardiff in Wales, UK, and the École Polytechnique Fédérale in Lausanne, Switzerland. All partners are striving to tap into the additional innovation potential of this technology.

Focusing on international markets. In-depth knowledge of a market is also vital for innovations. Carl Zeiss therefore specifically looks for answers to the questions of which innovations are wanted in the different international markets, how new trends are established and to what extent you can cooperate with regional partners. One project in this context is the Pilot Innovation Office in China (PIOC) – a type of interface between Carl Zeiss in Germany and the highly dynamic Chinese market. Dr. Chun Shi Gu runs the office in Shanghai. He and his team in China look for direct contact with scientists and cooperation partners and clarify the general conditions for specific projects abroad. Dr. Gu then evaluates the results together with Dr. Hexin Wang from the Technology Center at Corporate Headquarters in Oberkochen and the head of Carl Zeiss in China.

Setting foot on new shores. A pilot project in the beginning, the Innovation Office has now become an institution. Innovations know no bounds – particularly international frontiers. This is true not only for Carl Zeiss, but the entire German economy. The "Made in Germany" label has contributed to the country's position as the world's leading exporter year after year.

"The advantage is that the PIOC team is on site and can therefore immediately gather information and experience. I act as an agent between the corresponding specialist areas of Carl Zeiss in Germany and the experts on site in China – and vice versa."

Dr. Hexin Wang

However, this title is under siege. The German Office for Foreign Trade expects China to overtake Germany as early as 2008. This shows that there is no time to rest on our laurels. Faced with competition from low-wage countries, Germany can only score by relying on quality and on new developments in key technologies such as information and medical technology, and biotechnology and nanotechnology. However, future and pacemaker technologies in which you can reach new shores as pioneers are also important. This refers to promising, innovative technologies that are still at an early stage of development but also exhibit great potential, establishing completely new trends in individual industries – and maybe even changing the world.

The history

Milestones from Carl Zeiss

2007 *– A new era of microscopy begins with the helium-ion microscope.*

2005 *– Sub-atomic resolution was achieved for the first time using an UHRTEM electron beam microscope.*

1982 *– The laser scanning microscope, a microscope system with object scanning through an oscillating laser beam and electronic image processing.*

1957 *– Xenon photo coagulator based on the Meyer-Schickerath design: the first light-based surgical instrument is the predecessor to the laser for ophthalmic procedures.*

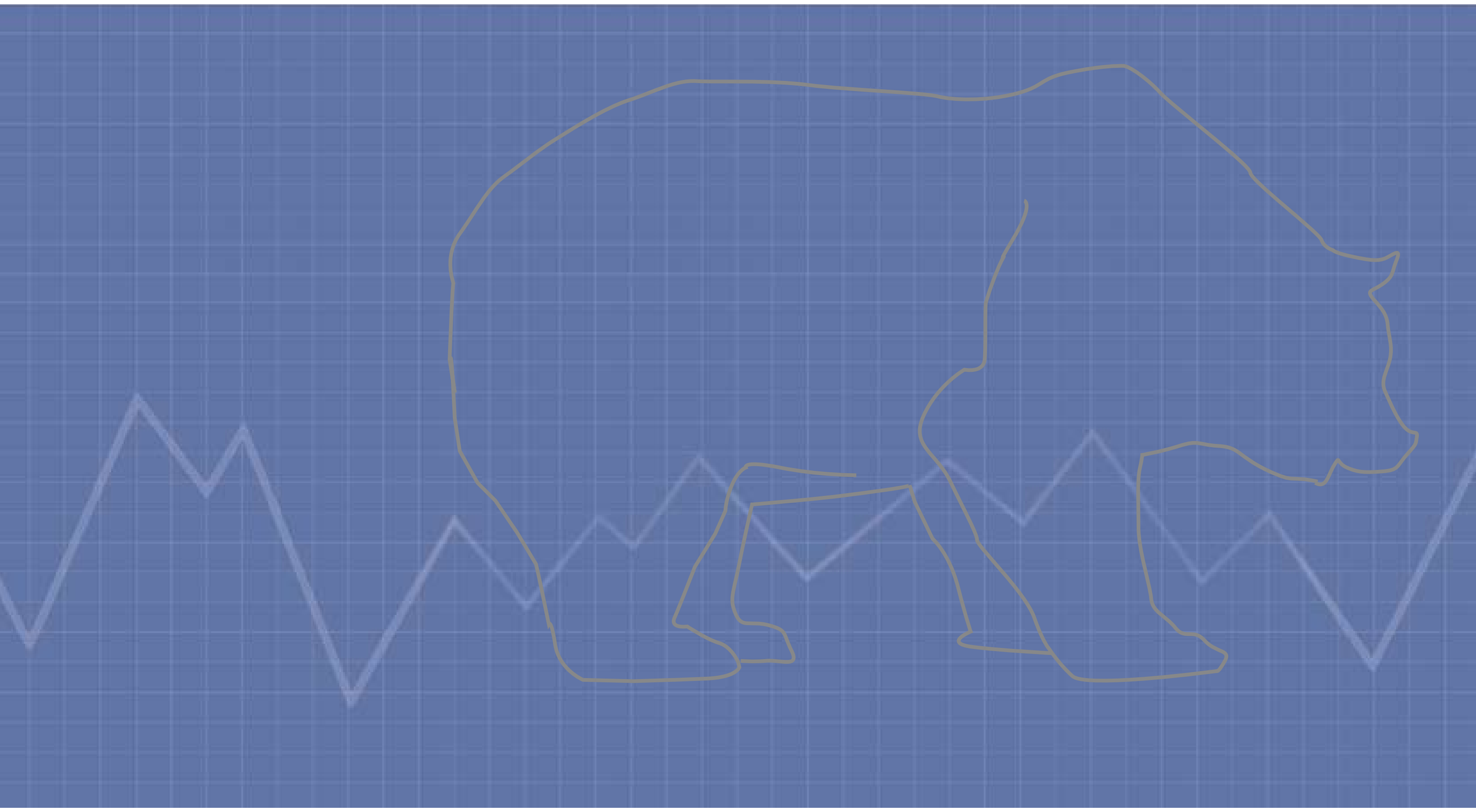
1936 *– First prototype of a phase contrast microscope based on Zernike's original design which won a Nobel Prize in 1953.*

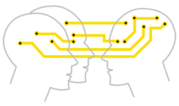
1923 *– Demonstration of the first projector for a projection planetarium (model I).*

You can find additional milestones at www.zeiss.com/innovation under History.

Floating Ideas

Employees submit innovative suggestions on a virtual platform

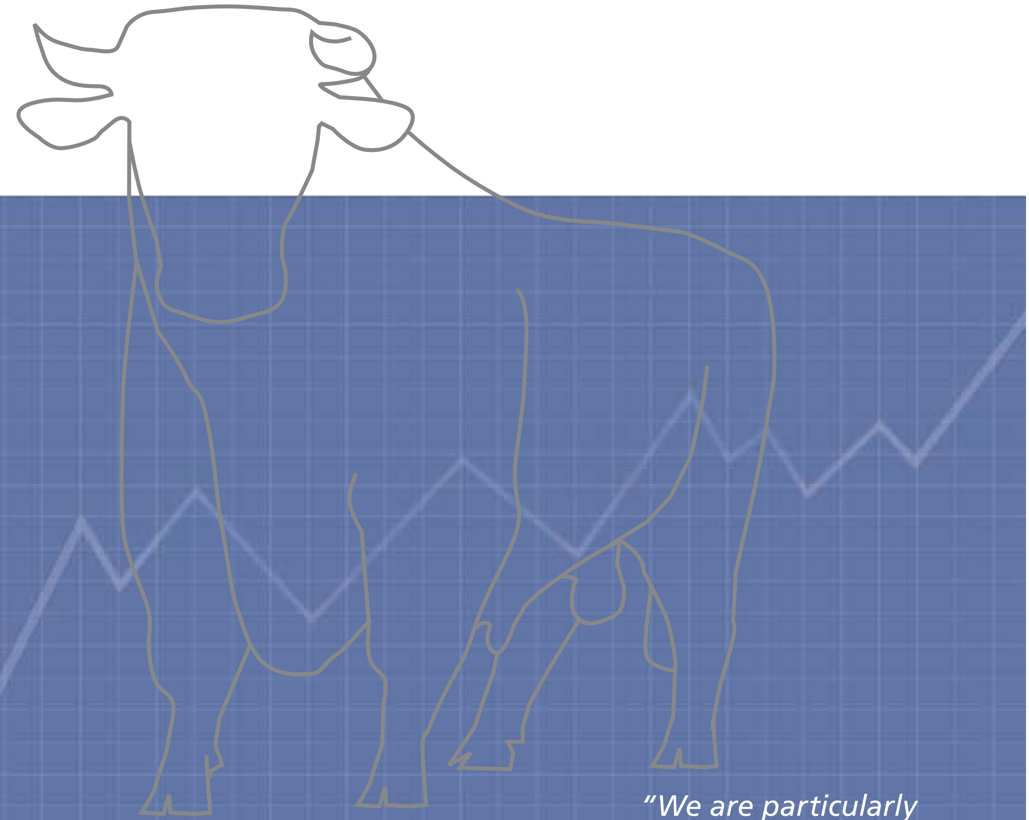




Ideas can only develop where scope for development exists and creativity is rewarded – such as the Carl Zeiss Idea Market staged by the company in 2006. The virtual idea market was based on a real stock exchange. However, at Carl Zeiss, ideas and Carl Zeiss Shillings (CZS) were traded. All Carl Zeiss employees had the opportunity to suggest a product, a business idea or a pioneering trend from the field of optical technologies. Rüdiger Kühnle, head of New Technology in Corporate Research and Technology at Carl Zeiss AG was in charge of the project and developed this innovative strategy together with Professor Dr. Martin Spann from the Marketing and Innovation Department at the University of Passau. Spann explains that "the market connects the generation of ideas with the aspect of simultaneous evaluation. Unlike an idea contest in which a jury alone reviews the ideas, the ideas on the Idea Market are evaluated by employees."

Enthusiasm abounds. As with a real market, ideas first had to pass the subscription period. The objective was to increase the start capital of 10,000 CZS and/or improve the value of your own portfolio by intelligently buying and selling idea stocks. A total of 650 employees from all over the globe submitted more than 420 ideas to the virtual platform for the one-month trading period.

Very promising bioscanner. Following an eventful month of trading, the external jury determined the value of each stock and the idea behind



"We are particularly pleased that all areas and hierarchy levels participated – from apprentices to Executive Vice Presidents."

Rüdiger Kühnle

it. A 2D/3D bioscanner was deemed particularly promising. This high-tech device will record single body features in 2D/3D using an innovative process and would therefore provide the foundation for a computer-assisted selection of artificial limbs, for example.

From an idea to an innovation. To ensure that visions become reality, the Carl Zeiss Innovation Team consisting of its head and staff from the Marketing and Development Divisions is currently assessing all ideas and deciding which of them will go into product development. Klaus Stiegeler, head of Marketing and Sales at Sports Optics and head of the Innovation Team announced that "the first products may already enter the market in 2008."

The details

Carl Zeiss Sponsors Young Researchers

Carl Zeiss has a long tradition of promoting talented young people. In addition to social projects, the company also supports scientific, technical and mathematical educational initiatives, in particular.

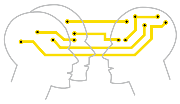
Carl Zeiss has sponsored the "Jugend Forscht" (Young Researchers) competition, the largest competition for natural science and technology in Europe, since 1997. The company has already hosted the competition for the East Wuerttemberg region for more than 10 years. In the 11 years of the regional competition, winners from Oberkochen have produced two 2nd place finishes and a 3rd place in the national competition.

“It All Starts with a Good Idea”

An interview with President and CEO of Carl Zeiss AG, Dr. Dieter Kurz

President and CEO of Carl Zeiss AG, Dr. Dieter Kurz.

Dieter Kurz talks about the German fear of anything new, the high-tech strategy, his own favorite innovation and his recipe for success.



Mr. Kurz, what is your favorite innovation?

The iPod; not so much for the technology – MP3 players had already existed for a while – but because of how it was marketed. The success of the iPod is based on two other factors: first, the connection to an Internet site where users can download music and other items, i.e. an entirely new sales channel. And second, the design. Suddenly, it was cool to own an iPod.

What can the German government do to make it possible for us to develop success stories such as the iPod?

Various projects have been promoted in Germany for many years. This has been very successful – particularly in optical technologies. For example, microlithography received a lot of support during the 1980s. The foundation for our current successes was laid back then. However, there are also weaknesses in addition to the good points: it is not enough to simply invest in research; the general conditions must be established to enable the implementation of innovations. Unfortunately, there are still too many obstacles in Germany. These include the reforms in healthcare intended to reduce costs. As a result, there is an innovation backlog. Better technologies that reduce costs over the long-term and improve the treatment quality for patients have not entered the market. A second example is the tax policy in Germany. Investors are not permitted to claim for losses carried forward with the acquisition of start-up companies, which often results in the failure to develop promising companies.

Are there any positive approaches from the government?

Of course there are. For example, the government’s high-tech strategy which connects researchers and companies from 17 technology fields. I am particularly pleased that optical technologies are also part of this strategy.

Doesn’t the government also have an obligation to create a general awareness of innovations? Other than policy makers, who else do you think is responsible?

As before, Germany is a country where people are skeptical of innovations. Awareness is something that will change slowly. Industry must take the initiative – and the media, too. Unfortunately, news about successful German innovators is rare.

What about schools?

Germany has neglected its schools in recent years. If we want to have young researchers in 10 or 20 years, major changes must be implemented very soon. Universities must also become more aware of their role. At Carl Zeiss we also need people with a good university education. This is an area where policy makers can become more active by creating the appropriate conditions.

In addition to the political conditions, what other criteria are needed for innovations?

Innovations require a culture that also permits an occasional failure. And, there can be no innovations without networks. In my opinion, the best networks are those in which universities and research institutes work together with experienced industrial companies. But you mustn't forget that innovations in Germany are always equated with more value creation and the generation of jobs. It is not about the products themselves.

Carl Zeiss generates almost 60 percent of its revenues with products not older than five years. How can you ensure that this ratio remains the same in the future?

Our recently completed global market survey shows that we are seen as a quality and innovation leader. To ensure that this does not change, we must keep our innovation pipeline filled. Therefore, we manage the company based on excellence: we want to remain ahead of the competition in all areas. This places heavy demands on all employees.

"Keeping the innovation pipeline filled," you said. Who is responsible for this?

This is the responsibility of every single employee, not only the researchers and developers, but also sales and service employees, and our people in marketing, product management and in production.

Finally, what is your own personal innovation goal?

I would like to see Carl Zeiss enhance its peak position, or become the leader, in all its fields of business – that is the basic requirement for the future success of the company. This tradition of innovation has served us well since the days of Carl Zeiss and Ernst Abbe.

This interview was conducted by Silke Schmid and Marc Cyrus Vogel.

The details

High-Tech Strategy: Objectives for 17 Future Fields

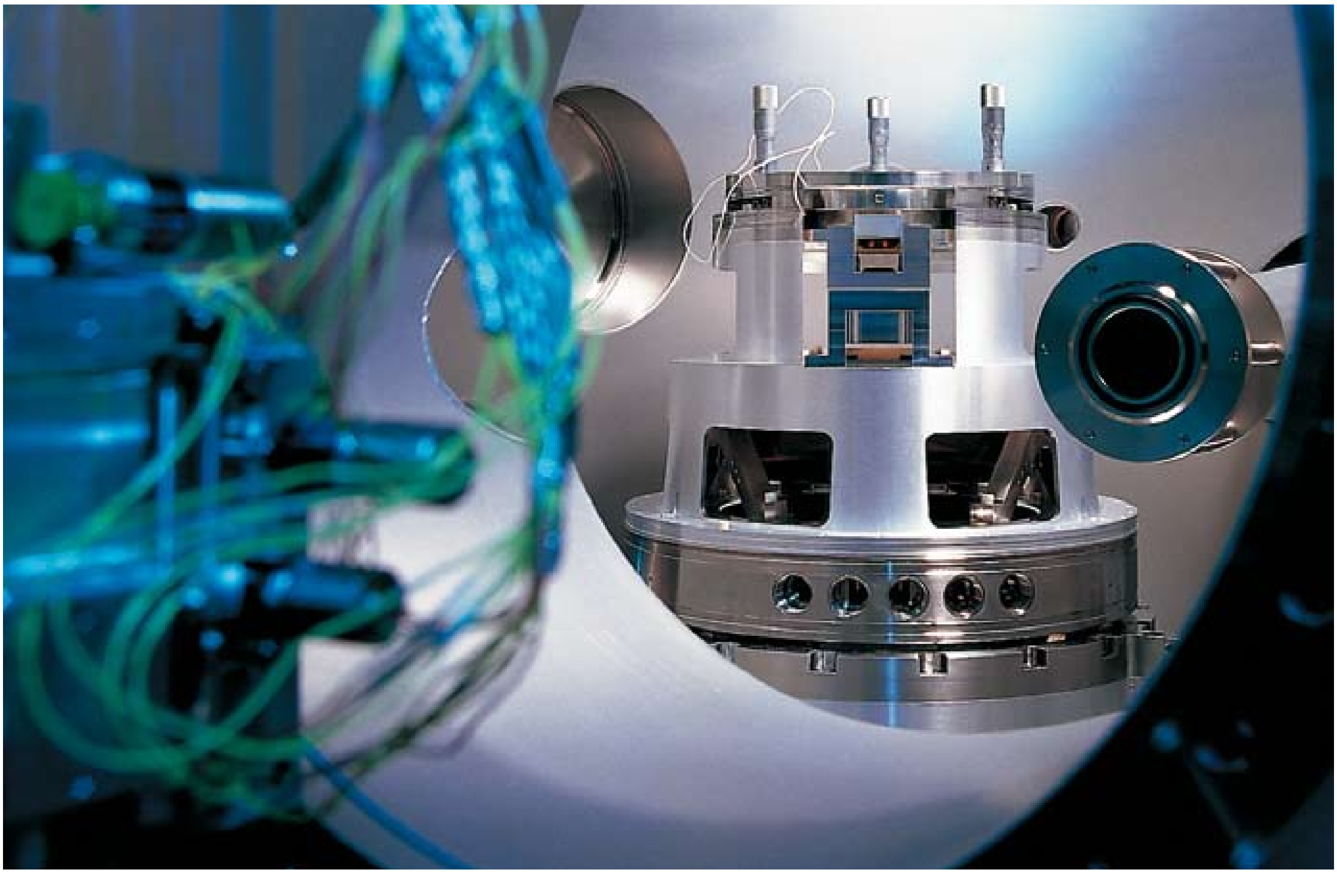
"For the first time ever, the German government has developed a comprehensive national strategy for all its ministries with the intention of making our country the world leader in the most important future-oriented markets." All political sectors that affect research and development will be focused on a clearly defined goal. This strategy puts the innovation policy at the center of government activities. The high-tech strategy establishes objectives for 17 cutting-edge fields of the future that will generate new jobs and prosperity in Germany. A schedule and concrete initiatives have been set up for each of these objectives. A brochure from the Research Minister says that "for the first time ever, each area covered by the innovation policy will have a clear timetable that takes both research funding and general conditions into account." The German government intends to invest around 14.6 billion euros in the high-tech strategy between 2006 and 2009.

(Source: www.hightech-strategie.de)

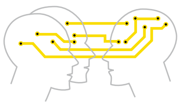
Guest Article

"Creating Value from New Knowledge"

Dr. Annette Schavan, Member of the German Parliament
German Federal Minister of Education and Research



Vacuum chamber of an EUV illumination system from Carl Zeiss.



Germany is the world's largest exporter of research-intensive industrial products. This is something the country can be proud of, but it cannot rest on its laurels. The world economy is undergoing a phase of rapid change and we must expand our current position.

The German government sees innovations as the key to meeting the challenges of the future and has therefore implemented a high-tech strategy in Germany. This sends a clear signal that it wants to promote innovation and secure a leading position in new technologies. The country is prioritizing education and research, and investing more than ever before. It is creating a new climate of cooperation between industry, science and politics. The course is being set for the future.

By the end of this legislative period, the German government will invest an additional six billion euros in research and development (R&D) alone. At no time in history has the German government ever invested this much to strengthen knowledge and expertise. Overall, 14.6 billion euros will be invested for cutting-edge technologies and inter-disciplinary measures as part of the high-tech strategy by 2009. This will bring us a great deal closer to increasing the percentage of research expenditures to three percent of Gross Domestic Product (GDP) by 2010. Now it is time for industry to do its part.

The International Monetary Fund clearly increased its growth forecast for Germany in its current report. The sustained good economic trend is driving expectations that industry, which is responsible for two-thirds of R&D spending, is investing more in research and development in Germany. This also applies to investments in the qualification and training of future and current employees.

Optical technology companies will play a particularly important role: they exhibit above-average research activities and growth. They are not only innovative, but also innovating. In other words, they trigger innovations in many other sectors of the economy. Mastering and wielding light is becoming the key to progress in an increasing number of areas. This is true of medical technology, solar technology, communications and data storage, and precision and flexible manufacturing and measuring technology. Germany is well-known around the world in all of these areas and is home to many companies that drive innovations. Therefore, optical technologies are a key aspect of the high-tech strategy.

The research union is a forum for driving cooperation between science and economy. Based on the suggestions of Dr. Kurz, we have jointly specified the next steps in optical technologies. We have agreed to strategic technology initiatives for organic photovoltaics, for OLEDs and for molecular imaging. In the future, we want to involve mid-sized companies, in particular, more closely in research and development. We are currently discussing the issue of how to meet the need for the next generation of skilled employees by generating interest in young people, particularly young women, for technical and natural science careers, and by eliminating hurdles for non-German specialists.

Innovation means organizing value creation from new knowledge. Many partners must work together to reach this goal. With the high-tech strategy, the German government has laid the foundation. Our message is: Germany is an attractive location. This is where you can find competitive partners for new technologies.

The person

Dr. Annette Schavan

The theologian and philosopher was appointed German Federal Minister of Education and Research in 2005.

In 1995 at the age of 40, Annette Schavan was appointed Minister of Education for Baden-Württemberg. She reorganized Baden-Württemberg's educational policy: she introduced the Abitur (graduation exam) after 12 years, foreign language classes in elementary schools and fought for uniform educational standards.

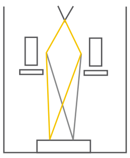
A Bone of Contention

If scanning electron microscopes had existed 150 years ago, science would have a few anecdotes less. And Rudolf Virchow would probably have not had the opportunity to make such a monumental mistake as he did with his views on the Neanderthal discoveries. However, as an examination of DNA was not even a remote possibility in 1856, let alone even thought of, scholars became embroiled in a bitter dispute about the bones of our ancestors.

Anatomical arrangement of bone fragments found during excavations in the Neander Valley to form a complete skeleton.

A New View of Prehistoric Man

Archaeological excavation site in the Neander Valley between Dusseldorf, Essen and Wuppertal.



It all started in 1856 in a quarry in the Neander Valley not far from Dusseldorf when workers discovered the petrified remains of a skeleton and a skull. "After careful examination," reported the Elberfelder Newspaper on September 6, 1856, "it has been determined that this being is a member of the flat head family that still exists today in the western part of the USA." The question of the day was whether "these bones belong to one of the original inhabitants of central Europe or if they are simply the remains of a marauding horde (with Attila)." Back then, it was only possible to speculate. High-school teacher and natural scientist Johann Carl Fuhlrott examined the bones and concluded that they had to originate from prehistoric man. Fuhlrott thus contradicted the traditional teachings of creation long before Darwin published his radical reinterpretation of the origin of man in England in 1871. And that in staunchly catholic Rhineland, of all places. Needless to say, this got him into hot water with the scientific community of his time.

Berlin-based pathologist Rudolf Virchow, who was already an authority in the field of medicine at the time, secretly examined the bones in 1872 while Fuhlrott was away and categorically rejected his explanation. The bones certainly come from our contemporaries! The unusual form of the skull is simply the result of an illness. For Professor of Anatomy in Bonn Franz Josef Carl Mayer, the noticeable curvature of the thighbone indicated an occupational illness. In his opinion, the bones belonged to a Cossack, legs curved from a lifetime in the saddle, who had set up camp in the area around Mettmann "in order to cross the Rhine on his way to France on January 14, 1814."

The details

Gilding No Longer Necessary
Until now, it was only possible to use a scanning electron microscope for examinations on electrically conducive material.

Organic specimens had to first be coated with conducting matter such as a thin layer of gold. The REM Supra 55 VP from Carl Zeiss eliminates the need for gold – an invaluable advantage for priceless specimens such as the bones of Neanderthals.

The instrument scans the surface of the bone with an electron beam to deliver high-resolution, high-contrast images.

A Neanderthal Gone Astray: Discovery of a Neanderthal skull in 1908 in La-Chapelle-aux-Saints, France.

From a primitive being to an artist. It has been clear since 1997 that Neanderthals were not the ancestors of Homo sapiens. They have common roots, but nothing more. People have long thought of Neanderthals as primitive, muscle-bound creatures with a protruding jaw incapable of any cultural activity who roamed the forests during the day with a club in their hairy hands and gnawed doggedly on their prey in the evenings. This image had to be revised no later than 1990. While rummaging through a drawer, Prehistorians at the University of Halle found what they thought were two 40,000 year old resin nuggets and placed them in the specimen chamber of a scanning electron microscope. To their astonishment, they discovered it was actually birch-bark tar, an adhesive not found in nature. Fire is needed to manufacture it. This was a scientific sensation. Until then, the invention of the first synthetic material was attributed to Homo sapiens. And there were still more surprises to come. The latest findings and analyses indicated that Neanderthals could speak, that they cared for the sick and injured and that they were artistic.

More expensive than moon dust. The bones from the Neander Valley have been stored at the Rheinisches Landesmuseum in Bonn since 1877. The site in the quarry where the bones were found was leveled while limestone was being mined. Scientists Ralf W. Schmitz and Jürgen Thissen did not succeed in finding the original site in the Neander Valley until 1997 after remains of Neanderthals had been found elsewhere. There, they discovered the bones of a second, smaller Neanderthal and finally, in 1999, a joint that fit exactly to the thighbone from 1856.

“A gram of Neanderthal bone is more valuable that the rocks brought back from the moon by Apollo 11,” said Schmitz. It is no wonder, then, that he had a queasy feeling one morning in 1996 when he asked bone preparator Heike Krainitzki to cut up one of the Neanderthal bones using a sterilized goldsmith’s saw. “After all, this is icon of German archaeology.” He placed the sawed-off piece of bone

Scientist Ralf W. Schmitz (right) with his assistant during an excavation.

in a sterile plastic tube, delivered it personally by car to the University of Munich where he handed it to molecular geneticist Svante Paabo. Twelve months later, in July 1997, the front page of trade journal Cell reported a sensation: "Neanderthals Were Not Our Ancestors." According to Paabo's genetic analysis, Neanderthals were not our ancestors; they were at best distant relatives.

This marked the dawn of a new era in the study of ancient humans, the rise of paleoanthropology to a high-tech discipline. In January 2007, a few months after the Rheinisches Landesmuseum in Bonn celebrated the discovery of the Neanderthal 150 years ago with the "Roots of the Human Race" exhibition, Schmitz, together with electron microscope expert Jörg Stodolka from Carl Zeiss, examined the bones of the Neanderthal using a *Supra 55 VP scanning electron microscope* from Carl Zeiss. The scratches on the bones, which were thought to have been created while excavating the bones, proved to be cuts from tools made of flint. Perhaps this sheds some new light on the previously unanswered question: Did the Neanderthals have death rituals such as those practiced by primitive Polynesians of the early 20^{th} century?

Dieter Brocksch

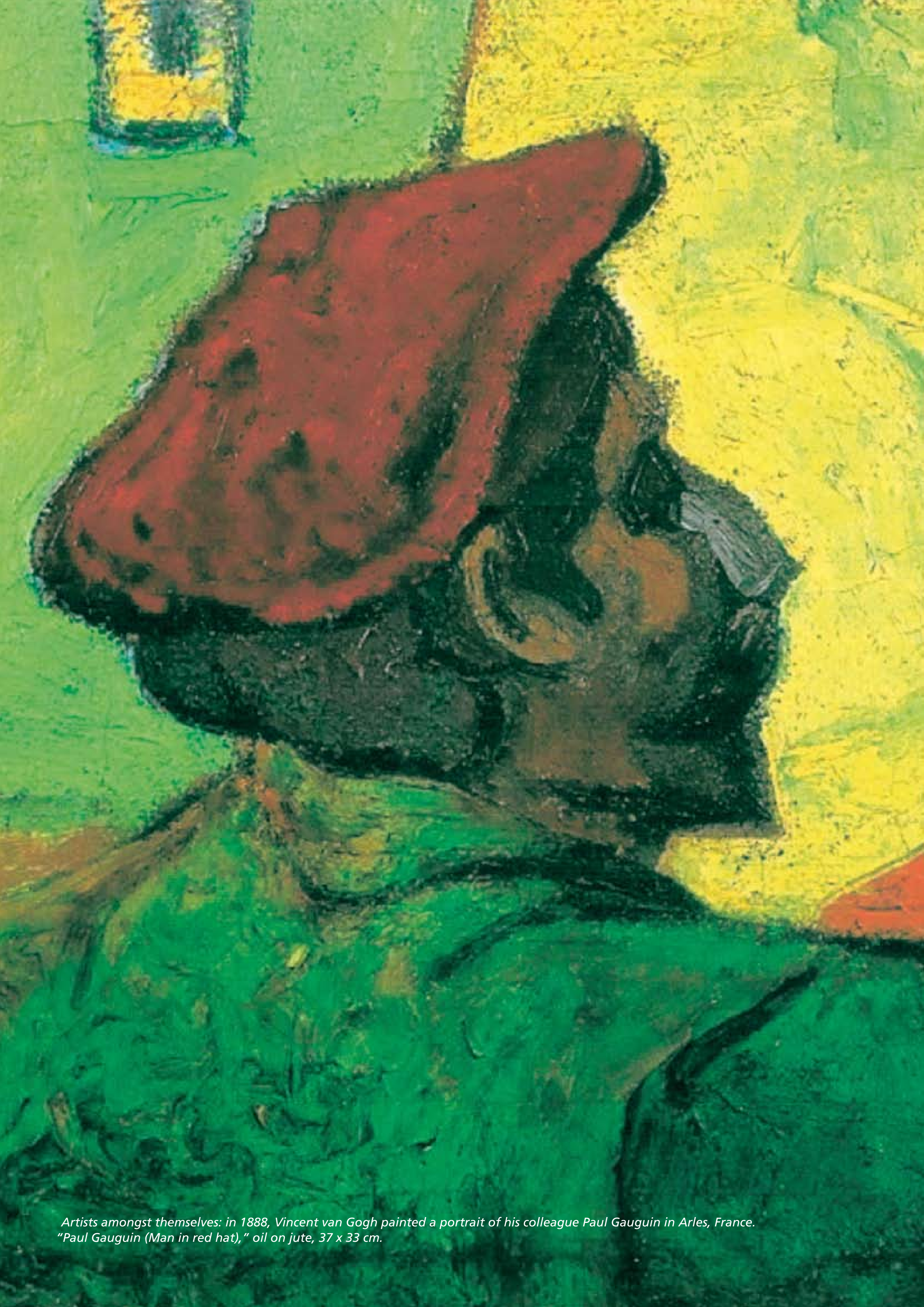
The details

Birch-bark tar from the super sauna

The first synthetic material produced by humans dates back to the middle Stone Age and was discovered in 1960 in Königsau, Germany.

Apparently, birch-bark tar was manufactured for daily use during the Stone Age using simple means. Chemical examinations and experiments have shown that the synthetic adhesive must have been produced using a low temperature carbonization process. In experiments, birch bark was heated in an

air-tight container to approx. 400°C and carbonized into birch-bark tar. As before, it is still a mystery as to how Stone Age people were able to master such a complicated process.



Artists amongst themselves: in 1888, Vincent van Gogh painted a portrait of his colleague Paul Gauguin in Arles, France. "Paul Gauguin (Man in red hat)," oil on jute, 37 x 33 cm.

Van Gogh – The Secret of His Painting

New view of the works of the Dutch painter

The lifework of Dutch painter Vincent van Gogh covers an amazing 913 paintings. However, experts have their doubts about the true origin of at least 50 of them. This has led to the analysis of selected paintings using state-of-the-art electron-microscopic methods in order to obtain exact knowledge about van Gogh's painting technique and the materials he used.

Paris, France, late summer 1887. Van Gogh is painting like someone possessed. With powerful, brisk strokes of his brush, he smacks the oil paint with consummate skill onto the white canvas. He was tortured by nightmares again the previous night. But painting is his redemption. The smell of turpentine hangs in the air of his tiny studio. Vincent van Gogh takes a slug from his bottle of absinth and lets his brush dance expertly over the picture: sunflowers.

Today, Vincent van Gogh (1853-1890) is world-famous for his unique paintings. His works fetch incredible selling prices at auctions. Nonetheless, little is still known about his painting technique. True, many hundreds of letters were received from the Dutch painter, in which he mentioned the pictures he was currently working on. However, art historians know relatively little about his studio work. It is precisely this information that is needed not only to faithfully restore his work, but also to identify forgeries. In a joint project, the Amsterdam Van Gogh Museum, Shell Netherlands and Carl Zeiss Nano technology Systems set out to find a solution: electron microscopes were used to analyze the microstructure and composition of pigments and primers.

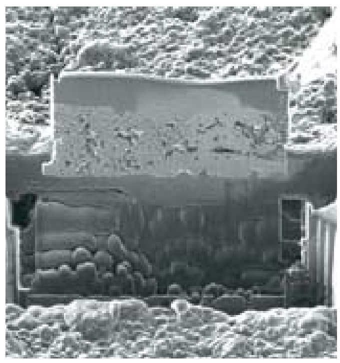
Sandblasting with nano precision. Paint particles were examined which had become detached from paintings such as, for example, "Run to Seed." Using a *ZEISS 1540EsB electron microscope* featuring cross beam technology, Ulrike Zeile, applications specialist in the Carl Zeiss Nano Technology Systems Division, prepared the ultrathin layers, or "lamellae," required for examination in the transmission electron microscope (TEM). The paint particles were processed with a fine beam of accelerated ions – almost like a sandblast applied with nanometer precision – in order to cut out the TEM lamella in the form of a cross section from the sample material." Here we were able to use the specially developed auto TEM preparation technique to obtain the TEM lamellae overnight, says Ulrike Zeile. The finished layer was about 0.1 micrometers thick. "In other words, it is about 600 times thinner than one of my hairs," says the physicist with a proud grin on her face. The benefit of the cross-beam method is that the cutting process can be observed live with the electron microscope function of the *1540EsB*.

Van Gogh – the self-taught man. "The red-haired madman" – "Le fou roux" – as he was known in France, the country to which he retreated to devote his full attention to his paintings. In the approximately ten years of his creative work, the Dutchman painted more than 900 pictures, in-

The details

Cross Beam technology/ Focused Ion Beam (FIB)

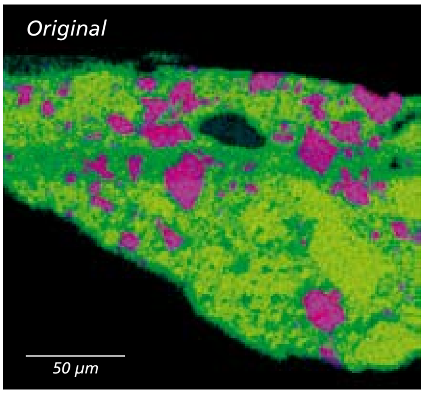
Cross Beam technology combines the possibilities of electron and ion beam microscopes. Using a focused ion beam (FIB), it is possible to process materials no larger than a few nanometers. The processing procedures can be monitored simultaneously with the electron microscope function. This makes it possible to deposit, or etch away metals or insulating materials which plays a key role in the semiconductor production. An additional application is the preparation of ultra-thin specimens, the TEM lamellas, that can then be analyzed in a transmission electron microscope.

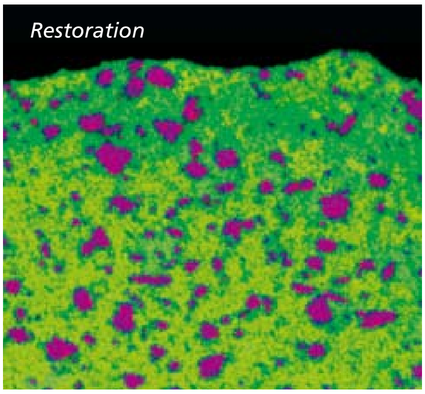


Microscopy subject: van Gogh's "Run to Seed."

cluding 23 self-portraits. By and large, he can be described as a self-taught man. Van Gogh studied at an academy of art for a brief period only. As he barely sold a single painting during his lifetime, he was always reliant on the financial support of his younger brother Theo, a successful art dealer. Theo also regularly sent him commercial painting utensils and paints, whose composition is currently the focus of van Gogh research.

Microanalysis with high tech. The TEM lamella cut out of the paint particle was examined in a TEM with the aid of energy dispersive x-ray analysis (EDX). In this method the sample is irradiated with a fine electron beam which triggers atomic processes in

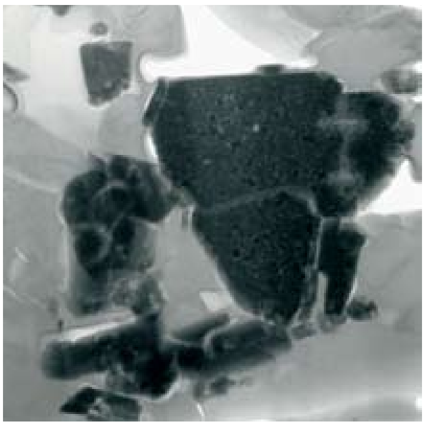




The EDX analysis shows that van Gogh's primer (left) and that of the restorer have different grain size distributions.

the sample material. This leads to the release of x-rays which are characteristic of each of the chemical elements present. The examination of the van Gogh pictures has shown that the primer contains the elements barium and sulfur in addition to lead. For priming purposes, van Gogh presumably used white lead mixed with barium sulfate (also known as permanent white or blanc fixe). A characteristic feature is that barium contains strontium, a peculiarity that makes it possible to identify the mining site where the mineral was obtained. These results help to allocate paintings and to ensure that the restoration is as true to the original as possible – from the canvas primer to the varnish.

Towards the end of his creative period, van Gogh's health deteriorated despite several stays in a psychiatric institution: depressions, hallucinations and self-aggression. On 29 July 1890 Vincent van Gogh died as a result of a gunshot wound which he had inflicted upon himself three days before. He once wrote to his brother Theo: "I don't know myself how I paint."



TEM examination of the crystalline structure.

Today, leading edge electron microscopes are helping to find an answer to this question.

Ingrid Fritz

The details

Energy-dispersive x-ray analysis (EDX)

In this procedure, the microscopic specimen is irradiated with high-energy primary electrons. Primary electrons knock out electrons from shells close to the nuclei of the specimen atoms. Electrons from electron shells farther away from the atomic center fall into the resulting gaps. The difference in energy between the electron shells involved is emitted as x-ray radiation.

This x-ray radiation is characteristic of each element so that it is possible to identify the elementary composition of a specimen and also determine the existing quantities. Combined with transmission electron microscopy or scanning electron microscopy, it is possible to display the spatial distribution of the elements.

Even more Safety – JetSCAN Replaces Man

The risk declines. Carl Zeiss is fully aware of the value of *JetSCAN*. The company presented Daniel Sims from Carl Zeiss SMT in Cambridge with the Innovation Award in the Innovative Business Design category for his work which opened up a new market for his employer: aerospace.

Military jet crashes due to engine damage have become rarer. For example, before the introduction of *JetSCAN*, the US Air Force lost a plane about every six months. This number has been reduced to practically zero since the implementation of *JetSCAN* to monitor jet engines. The *JetSCAN* maintenance system, which has already been sold more than 90 times around the world, is a key element of this improvement. This is primarily due to how the system was developed. "We knew what we wanted to build and who would buy it," says Sims. "And we were a small team that dedicated all its efforts to its work without being distracted by other projects." This new system replaces manual engine inspections which were so ineffective that the US Air Force lost a plane about every six months. *JetSCAN* establishes a new, higher level of safety as it considerably reduces the risk of engine failure. With it, the majority of signs of wear on the gears are detected in time. An additional benefit: *JetSCAN* makes labor-intensive maintenance work a thing of the past, thus reducing costs.

Particles in oil. *JetSCAN* utilizes the technique used in a scanning elec-

ual Jet Engine Inspections

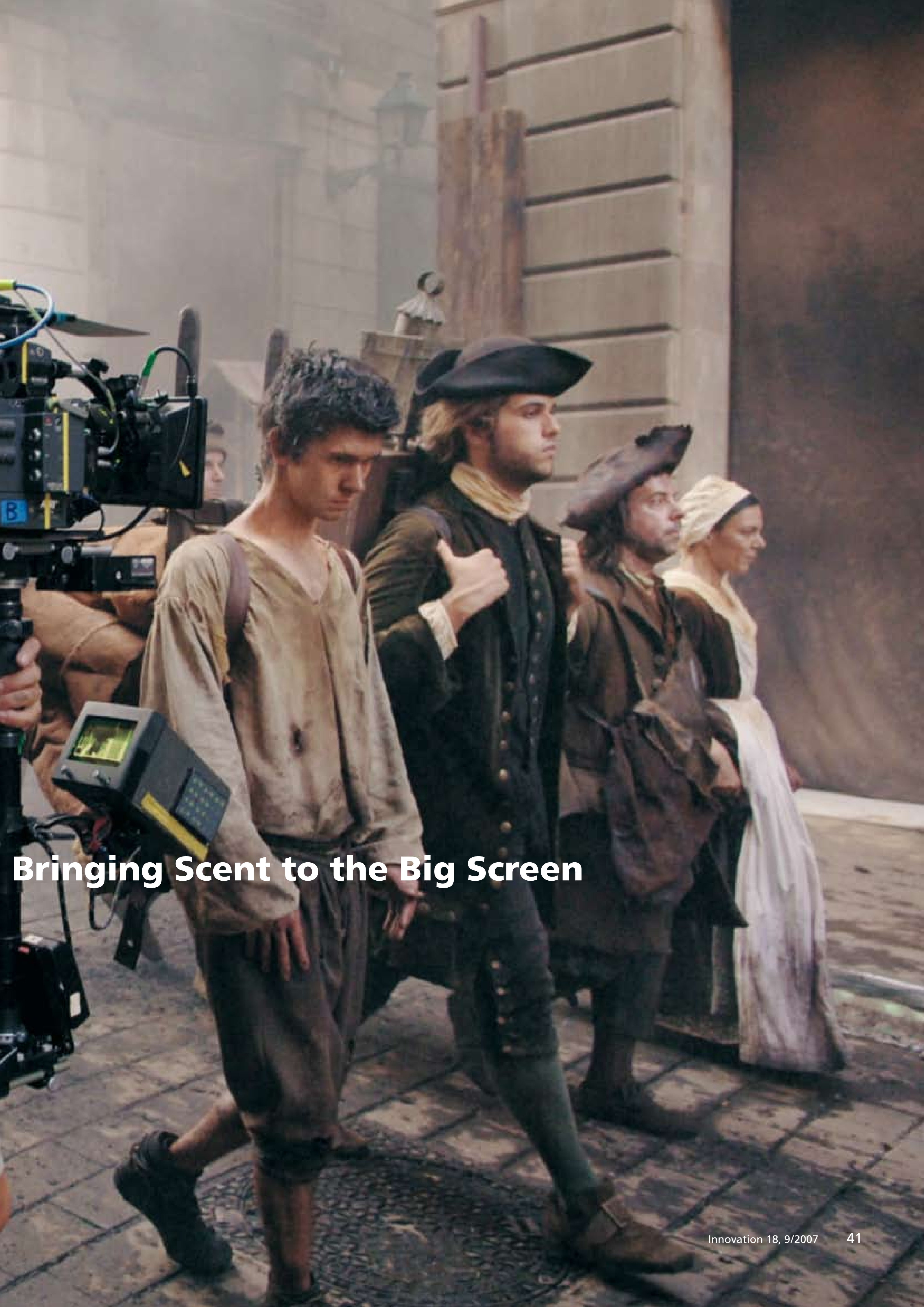
tron microscope to examine the oil deposits in the engines. If too many particles are detected, the machine is sent to the workshop. The oil deposits are placed in the inspection machine via a special filter. The system starts automatically, moves independently from specimen to specimen and measures the size, position and composition of the particles. The measuring results are compared with the data stored in a database for the respective engine. *JetSCAN* then calculates if the engine is operating normally or if it must be overhauled.

Soon to be standard equipment. The transportable inspection device for jet engines was developed within three quarters of a year as part of a joint project of Carl Zeiss, Rolls Royce and the Royal Air Force. Both partners contributed their knowledge of jet engines, maintenance measures and error mechanisms, the Process-specific Tools Department at Carl Zeiss SMT developed and built *JetSCAN*. “We had to first convince the designers who usually develop highly complex products that a simple, turn-key system was the right approach,” says Daniel Sims. A success as it turned out. Finally, the Air Force was convinced that *JetSCAN* was exactly what it had always been looking for: an easy-to-use electronic monitoring tool that can be simply transported from one machine to the next using a forklift. It is operational within 40 minutes. *JetSCAN* has now become standard equipment for the maintenance of jet engines and makes flying safer.

Ursula Walther

Zoom Magic

Is it possible to make the scent of young women visible? Not an easy task. Cameraman Frank Griebe succeeded in such a way in the movie *Perfume* that he was honored with the German Film Award. The kudos for best camera work and image composition were not the only prizes bestowed on the cinematic masterpiece which had already attracted more than five million visitors within 50 days of its world premiere.



Bringing Scent to the Big Screen

Shining the Spotlight on Grenouille's Nose

Producer Bernd Eichinger, director Tom Tykwer and leading actor Ben Whishaw received the 2006 Bambi for the best German movie. At the beginning of May 2007, "Perfume – the Story of a Murderer" received the German Film Award for best movie (silver award), best editing, best production design, best costumes and best sound. In his report on filming, Frank Griebe states that an award-winning movie is not only the result of an ingenious director, but also hard work. He also makes perfectly clear that "nothing works without the right tools." Griebe filmed Perfume using the *Master Zoom,* the latest high-performance zoom lens from Carl Zeiss, which is used for major international movies.

Frank Griebe, who used cameras from Munich-based Arnold & Richter Cine Technik (ARRI), raved about the ZEISS lenses: "We used the new *Master Zooms*. This is an outstanding lens and certainly the best that I have ever worked with." Tom Tykwer is a passionate advocate of high-speed zoom lenses. You can change the image frame without having to change the lens – a real time saver.

Both the book and movie deal with smell, live from scents. Tykwer and his cameraman had to make everything vividly described by Patrick Süskind in his novel come alive. Real scents were not possible. The first and only real attempt to give the audience some-

thing they can really smell occurred in 1960's "Scent of Mystery" which turned out to be such a flop that no director will ever try it again. However, Griebe had to nonetheless bring the subject to the audience in a less real way and still let them get a whiff of it in a manner of speaking. He accomplished this by repeatedly focusing on the nose of the protagonist Grenouille – a challenge for any lens and testimony to what ZEISS lenses are capable of. Griebe used *Master Prime* lenses and the *Master Zoom* for the majority of his work. High-speed lenses were an absolute must for a movie in which half of the action is in the dark. The audience should still be able to see Grenouille in a night scene as he lurks in the gloomy shadows of a dark room. Black is not black and, in reality, the shadow of the murderer can be clearly seen against the dark background if you look closely. The gradual shades of the non-color black were later optimized using *Master Prime* lenses by digitally editing the film material. From the beginning, Griebe bestowed his trust in a tip from an experienced colleague: "Don't rely on digital editing as the solution to all technical problems. Make it perfect from the start."

Ursula Walther

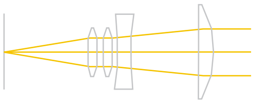
The details

The Author and His Book

World famous, but still unknown. Patrick Süskind is not a man for publicity. He did not even travel to Munich for the premiere of Perfume, a special radio feature on "famous Bavarians" had to take place without him, and he does not accept honors and awards. Born on Lake Starnberg in 1949, Süskind divides his time today between Munich and France. He wrote Perfume in 1985. It has since been translated into 46 languages, sold around 15 million copies and was on the bestseller list of German magazine Der Spiegel *for nine years.*

A Seductive Smile

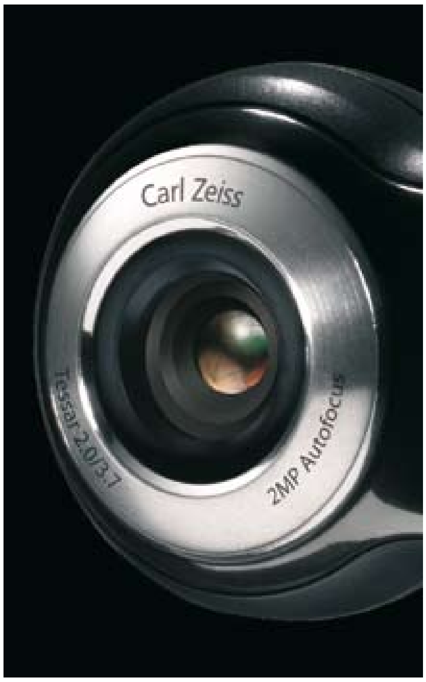
New webcams promise clearly improved images



Chatting through a webcam is not the same as a candlelight dinner. However, it is still more personal than an anonymous exchange of words, that is, of course, if you have a high-quality camera. Judging from the statements of chatters, this is not always the case: "I was only able to show the person at the other end that I was still alive if I placed the camera in front of a large window on a bright day." Many Internet users have now turned their hopes to webcams with better lenses.

The first webcam was simply a social toy. Its inventors installed it in 1991 in the computer lab at the University of Cambridge. They were not interested in spying on colleagues at work in other offices; they had more important things in mind: Specifically, they wanted to avoid unnecessary trips to the coffee machine. The *Trojan Room Coffee Pot Camera* enabled all employees to see the amount of coffee in the coffee machine from their desks, initially only at the university, from 1993 even on the World Wide Web. Today, the most famous Cambridge coffee machine can be seen online at the website of German magazine Der Spiegel, constantly watched by two webcams.

Apart from professional cameras, until now webcams usually only delivered dimly lit images. In the best case, they can remind you of candlelight and romance; in the worst case, it was almost impossible to see anything. Two leading companies decided to do something about this problem: Carl Zeiss and Logitech. Founded in Switzerland in 1981, Logitech is known for the invention of the laser mouse and is the world's leader in webcams with ten years of experience in video technology. Carl Zeiss has already demonstrated its excellence in high-quality compact lens modules in collaborations with Nokia and Sony.



Up close and personal: the webcam with the compact lens module from Carl Zeiss.

The new webcam models which were developed for computers and laptop monitors will even enable the chatter to recognize the seductive smile of the person at the other end. If this much closeness gets too intimate, the user can simply unplug the camera.

Computer revolutionary: Apple boss Steve Jobs during the presentation of the iPod.

Innovations – The Sign of Progress

Around the end of 1899, the head of the US patent office in New York attracted a lot of attention when he made an extremely unusual request, especially for a civil servant with a cushy government job. In a letter to the mayor of the city, he requested closing the office: "Everything that can be invented has been invented!" The office that he headed was no longer needed. Obviously, a much higher authority did not share his opinion. His request was rejected on the grounds that even if the number of innovations does not continue, one or two more must be expected in the 20th century that require patents.

What we may chuckle at today, had a very real background at the end of the 19th century: never before had there been so many inventions in such a short time as in the period between 1850 and 1900. All types of machines replaced manual work and heavy labor. They were driven by new turbines and gas or electric engines. Contrary to every prediction of health or nervous breakdowns, people quickly moved about with increasing speed in fast trains and cars, took to the air in balloons and Zeppelins. They communicated via telegraphy and telephone, listened to music from gramophones and radios, took pictures and made videos of themselves and the world. What important things could possibly follow these innovations? There was legitimate doubt concerning the necessity of a patent authority.

However, this no doubt, well-intended request by the head of the patent office did not take into account all the never-satisfied inventive spirits who have driven the progress of mankind since the dawn of civilization. The spirits who were never content with the knowledge available to their generation, who attempted to improve imperfection in order to leverage their newly gained knowledge. Socrates irritated the citizens of Athens with his provocative claim that "I know nothing except the fact of my own ignorance." His distinguished successor Aristotle summed it up more dogmatically: "thought alone moves nothing, only practical thought that is directed towards a purpose."

It is impossible to want to churn out all the names of those who have since expanded the horizon of our knowledge true to these Hellenistic wisdoms. Their conclusions provided the "innovatio" with many promising perspectives. Thus, it was a bold assumption in 1899 that people of the 20th century would be satisfied with the inventions of the 19th century. Exactly the opposite occurred.

Everything can always be done better than it is being done.

Henry Ford I, 1863–1947

As industry expanded, it brought about an incredibly productive symbiosis between scientific research and technology. The founding generation of the new, increasingly automated manufacturing plants still largely recruited from the extremely gifted mechanics – self-taught inventors and engineers. However, their pragmatic approach to life quickly recognized the usefulness, the necessity, of securing the implementation and objective of their inventions with a science-based foundation. They strived to be close to renowned universities.

And science left its time-honored ivory tower to pure research and education. Exemplary networks of successful collaborations were founded in the 19th century. While industry increasingly used scientific insights, physicists and chemists increasingly helped themselves to professional, ever more precise instruments and apparatus production. Three names represent a classic example of this cooperation: Carl Zeiss, Ernst Abbe and Otto Schott.

In his optical workshop in Jena, Carl Zeiss (1816–1888) produced magnifiers, eyeglasses and, most importantly, microscopes for the nearby university. Physicist and university professor Ernst Abbe (1840–1905) improved their lens design and illumination using his analytical calculations for the microscope. Chemist Otto Schott (1851–1935) developed the special glass needed. Their cooperation revolutionized the construction of microscopes. The new instruments, which were soon to be mass produced and thus widely available, triggered a dramatic increase in biological and medical research results.

Using a microscope, Robert Koch and his employees recognized the viruses that cause tuberculosis and cholera. Their discovery helped effectively fight these epidemics. In 1890, Emil Behring developed antitoxins for diphtheria and tetanus in this manner. This enabled him to invent the principle of serotherapy for which he received the first prize in medicine in 1901 from the Nobel Foundation founded a year earlier in Stockholm. Physicist Wilhelm Conrad Roentgen was also honored with this award for his discovery of the mysterious x-rays that were later named after him.

Knowledge is not enough – you must actually apply it. Wanting is not enough – you must actually do it.

Johann Wolfgang von Goethe, 1749–1832

In addition to the traditional fields of physics and engineering, science and industry entered into new cooperation models, particularly in the field of chemistry. Vaccines from test tubes, vitamins and hormones from lab beakers, inorganic fertilizers and colors, synthetic textile fibers and rubber – doctors, biologists, chemists and physicists began deciphering and recombining the formulas of nature. Their developments led to the creation of new industry sectors such as petrochemistry and pharmaceutical production. The age of synthetic materials was born.

In those days, the buzz word was not innovation, but progress. Simply calling the results from science and technology innovations seemed contradictory to the zeitgeist. An enthusiasm extending across all social strata and forces demanded far-reaching recognition of these new insights and achievements.

In Germany, land of poets and thinkers, people praised them with quotes from well-known greats. Trade publications from the National Metrology Institute in Berlin used maxims such as progress is an "obligation of humanity" (Kant) or the "unimpeded perpetual progress to new pleasures and new perfections" (Gottfried Wilhelm Leibniz) for headlines in 1912.

In competition with aspiring industrial nations, the results of scientific research became a matter of national prestige. However, the peaceful competition lost its innocence as academics provided their knowledge for the arms build-up for two world wars. The enthusiasm accompanying progress suffered permanent damage. Leading minds were discredited for disseminating their knowledge. Sometimes even unjustly! In August 1939, Albert Einstein informed U.S. president Roosevelt about the – possible – development of the atomic bomb in Nazi Germany. The USA succeeded in building the bomb first. Einstein was not involved but repeatedly warned of the consequences. On July 1, 1946, his portrait appeared on the cover of Time Magazine next to his famous formula $E = mc^2$ and a picture of a mushroom cloud. The caption below the collage began with the words "Cosmoclast Einstein." The genius whose theory of relativity changed all existing conceptions of space, time, energy, light and matter withdrew from public life and led a life of loneliness.

Imagination is more important than knowledge.

Albert Einstein, 1879–1955

Swiss-American physicist and Nobel Laureate Wolfgang Pauli publicly acknowledged that the power of knowledge also has "its dark side." Carl Friedrich von Weizsäcker, German physicist and philosopher turned towards peace research and succinctly demanded in 1957 that we should not do everything that can be done.

These were the first reminders of the dedicated responsibility we all share for developments based on scientific knowledge. To what extent was the basic idea of progress still valid – the idea that free research and the application of natural sciences themselves will lead to a humanization of society? New fields became established at universities and institutes: future research and assessment of the consequences of technology. In its Human Development Index (HDI), the United Nations defined the most important indicators of progress: long life, health, self-determination, education and peace. What promotes these objectives is understood around the world today as progress. Research, just as technical implementation, has had a great effect on this. Thanks to efficient medical care, improved hygiene and healthier eating habits, life expectancy has increased around the world by approximately 30 years since the beginning of the 20th century. Are we really aware of the value of this progress? What do we do with this gift? Do we use the extra time available to us to solve the problems that still exist and to drive progress even further?

> *"Real progress lies in analyzing and understanding the many mistakes made in its name – and, above all, correcting them."*
>
> *Sadruddin Aga Khan, 1933–2003*

Progress is more than welcome in daily life when it deals with improving a toaster, television reception or the comfort of an automobile. It is only in its complexity that it meets with increasing skepticism. The primitive fear of everything new and unknown still exists and many innovations require more and more know-how to assess their impact. Therefore, generally rejecting all efforts at progress would be the same as taking a step back. Strictly speaking, progress is never the finite goal. The progress efforts of preceding generations assumed that energy sources and resources were unlimited, their ignorance of its impact on the climate and the environment led to subsequent damage. Should they therefore be condemned?

Nowadays, scientific research is able to recognize the mistakes of the past. It is now up to us to correct these mistakes. A well-founded therapy should follow every thorough diagnosis. Are we capable of this? Definitely, if we have the desire and will to do so. Together, science and technology offer the necessary tools – outstanding innovations that we realistically no longer immediately consider to be progress in their own right – that, as components of progress, enable sustainable innovations step-by-step in the longer term. Its still valid objective: humanization and improvement of societal living conditions. We are coming closer to these conditions everywhere on our ever smaller world.

This is the challenge for the 21st century. It is doable, however not if we are mired in self-pity and resigned pessimism towards the future when confronted by its admittedly growing amplitude. It requires self-confidence, energy and growing optimism. Let us rise to the challenge. In doing so, we will muster the necessary self-critical composure in the knowledge that current contributions are also only directional signposts on the road to further progress that will be corrected and redefined at some point in the future.

> *If it is different*
> *it is not necessarily better.*
> *But, if it is to get better,*
> *it must become different.*
>
> *Georg Christoph Lichtenberg, 1742–1799*

This statement made in the scientific, philosophical essays of the University of Göttingen Professor, one of the leading all-round scholars of his time, is still valid today.

Manfred Schindler

Preview of Innovation 19

Cover story: Declining budgets, aging society – the healthcare systems around the world are faced with major challenges. Modern medical technology can help overcome these obstacles, with new imaging techniques, for example.

Report: A new era of microscopy begins with the helium-ion microscope. The first instrument has now been delivered to an institute in the USA.

Report: Birdwatchers demand the utmost on their equipment – rightly so. Only the best optics and mechanical components deliver fascinating images.

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Editors:
Silke Schmid (Editor-in-Chief)
Dr. Dieter Brocksch, Gudrun Vogel
Carl Zeiss AG
Corporate Communications
Carl-Zeiss-Str. 22
73446 Oberkochen, Germany
innovation@zeiss.de
Phone +49 (0) 7364 20-8208
Fax +49 (0) 7364 20-3122

Translation into English by:
Carl Zeiss Communication Services

Contributors to this issue:
Dr. Ingrid Fritz, Carl Zeiss
Manfred Schindler, Maren Becker, MSW
Ursula Walther, Simone Urban,
Thomas Nordiek

Conception and design:
MSW, Manfred Schindler
Werbeagentur OHG, Aalen
www.msw.de

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Carl Zeiss AG
Innovation editorial staff
Renate König

73446 Oberkochen
Germany

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Carl Zeiss AG
Innovation editorial staff
Renate König

73446 Oberkochen
Germany

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Carl Zeiss AG
Innovation editorial staff
Renate König

73446 Oberkochen
Germany


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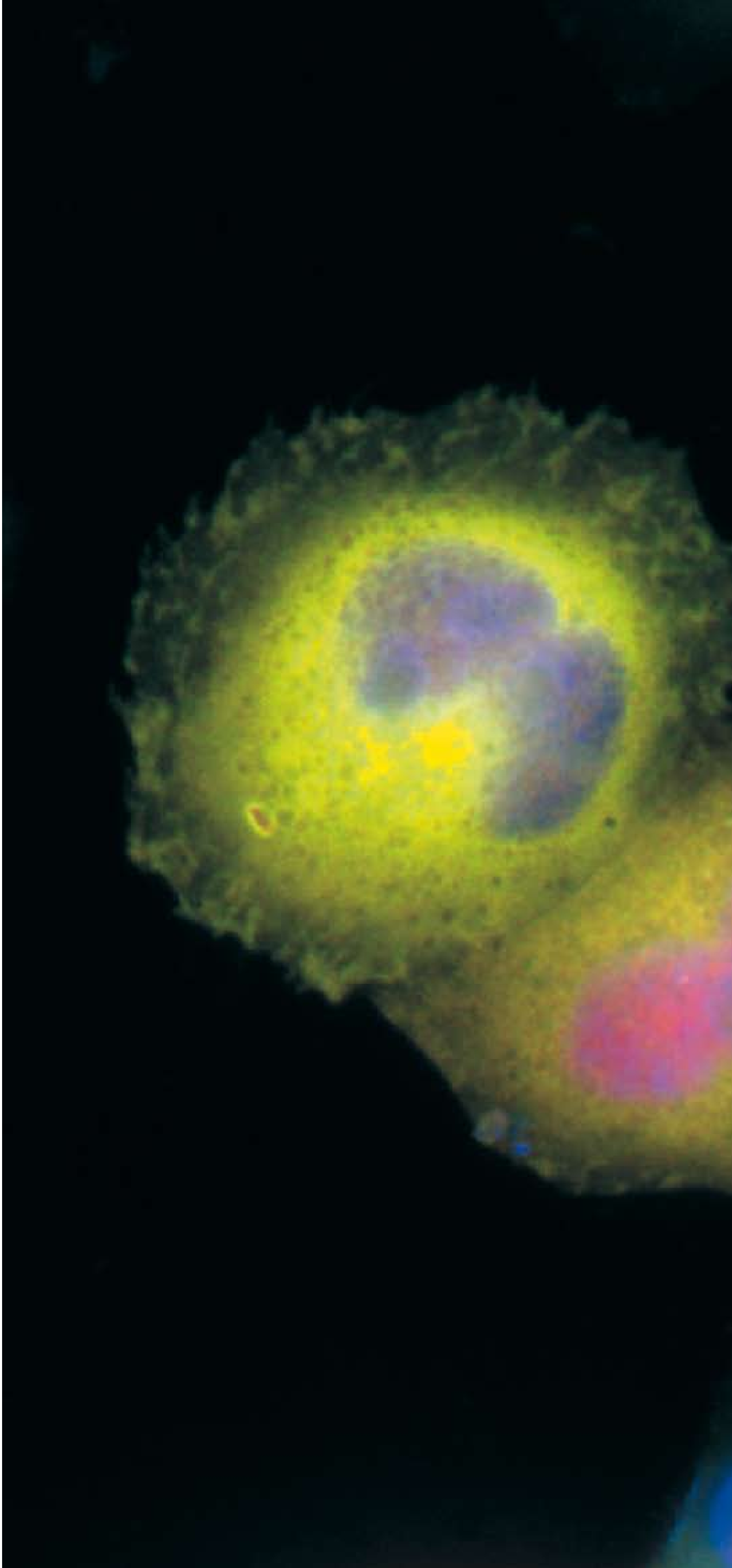

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