Firefighting
Thermal imaging camera sees through smoke

Neurosurgery
Operations in full consciousness

Neonatology
Better chances of survival for preterms

The Versatile Gas
Remarkable carbon dioxide
Without fire there would be no civilization, the origins of which are told in millions of cuneiform characters which were first burnt into clay tablets more than 5,000 years ago. The taming of fire revolutionized mankind’s diet and the preservation of food. But untamed, fire can level houses, cities, and whole tracts of land. By inventing the fire pump more than 2,250 years ago, the Greek naturalist and engineer Ktesibios signaled the beginning of mechanized firefighting.

“Without fire there would be no civilization, the origins of which are told in millions of cuneiform characters which were first burnt into clay tablets more than 5,000 years ago. The taming of fire revolutionized mankind’s diet and the preservation of food. But untamed, fire can level houses, cities, and whole tracts of land. By inventing the fire pump more than 2,250 years ago, the Greek naturalist and engineer Ktesibios signaled the beginning of mechanized firefighting.”

Senior Pastor Wilhelm Mildenstein, St. Mary’s Church Lübeck, on January 16, 1928, at the funeral of Bernhard Dräger
The human brain consists of up to 100 billion nerve cells. They and their connections are what make up the SELF – and these operations so difficult. More starting on page 22.
People going places

Delynn Mullins, mine rescuer at TECO Coal in Hazard, Kentucky / USA

“Coal mining is in my blood – it’s a family tradition. I’ve been a miner for 26 years and in mine rescue for six of them. When you go down with your friends every day, hundreds of meters into the earth, you sometimes imagine how you would feel if something were to happen there. You could help them, and that’s why I joined mine rescue. We train once a week for things like mine explosions: the ceiling’s partially collapsed, methane gas fills the shaft, miners are injured, others are missing. We strap on our breathing apparatus, put on our masks, and go in. We prop up the ceilings, find the miners, bring them outside, ventilate the shaft and fill it with fresh air so that work can go on. There are six of us and we can rely on one another one hundred percent.

Our equipment plays a key role. We need clean air from the breathing apparatus, and our gas measuring devices have to warn us reliably. One breath of toxic atmosphere without a mask and you can fall down dead! If – God forbid – anything were to happen one day, we would be ready to go in straight away.

My wife and I got to know each other at school. She never tried to persuade me not to do my work. She knows it’s my life. I always kiss my wife before I leave the house and say, ‘I hope I come back.’ Not everyone is made for mine rescue. We go in when others try to escape. You definitely need a special attitude towards life and you have to be ready to risk your life for others. In our training sessions and in competitions I often get nervous before things begin. Then the adrenaline kicks in and everyone is totally focused on the task in front of them. Knowing that you could help if something went wrong – that alone is a good feeling.”
“We were called out to the cotton fields around Emerald, around 800 km north-west of Brisbane. It was a typical mission: too far for an ambulance yet very urgent. A worker had got stuck in a harvesting machine and his leg had got wrapped around part of it. We freed the man from the blades and flew him to the nearest suitable hospital. He survived despite serious injuries. Our planes are equipped as compact intensive-care wards, since anything can happen out there – a fire victim in the morning, a premature birth in the afternoon, and a heart attack in the evening. I like the diversity, and I also like the independence: we fly 80 percent of our missions without a doctor. That is why flight nurses have to be midwives too, they have to have five years of clinical experience in emergency medicine, and additional qualifications. I first heard about Flying Doctors while I was backpacking in 1989. It was clear to me: that’s what I would like to do. I went back to London and underwent training. I’ve been here for more than ten years now. In Queensland we care for people over an area of 1.7 million square kilometers. We provide Primary Health Services in the Outback. As a nurse manager, I lead a team of nurses which involves planning rosters and organizing things. I fly less than I would like to, but even organizing can be thrilling. During the floods at the beginning of 2013 we helped to evacuate a hospital: 131 patients had to leave Bundaberg when the river flooded the town. Our hangar in Brisbane became a transit clinic. The Air Force and other organizations also flew patients out, but we took responsibility for intensive-care patients and babies in special care nursery.”
WHAT THIS IS ABOUT

Keywords
Each of them on this double-spread reveals a new aspect of an article and shows it from a different perspective. Every theme, after all, has many facets. The explanations and definitions of these keywords draw from lexicons, dictionaries, and encyclopedias. They also include forays into other fields so that we can view some of their aspects through different eyes.

TOMATOES
From the greenhouse
Tomatoes – those apples of love – have not always had a good reputation. There was a time when consumers vilified mass-produced tomatoes from Spanish and Dutch greenhouses, criticizing them as ‘water you can slice’. But that was long ago. Nowadays they are, in their many varieties, a pleasure to eat. Braised, for instance: heat cherry tomatoes slowly in a pan with some olive oil until the skins burst. Add salt and you’re done. Or dried: press rosemary needles into sliced tomatoes, salt them, and heat them at 80 °C in the oven (with a cooking spoon to hold the oven door ajar). Later, add some olive oil, and they’re finished. None of that can be done without CO₂:
more starting on page 8

TEST
Time lapse performance
Material tests intentionally overload objects to simulate their behavior over a long period of time or when incorrectly used. Destructive testing is particularly spectacular: compressed air cylinders burst, plastics catch fire, metals buckle in a notched bar impact test. For the safety of customers:
more starting on page 52

TREPHINATION
A hole in the head can do you good
How to cure unimaginable headaches? More than 10,000 years ago people thought that the pressure in your head needed relief – so they drilled a hole in your skull to alleviate it and, supposedly, make you well. Some patients even survived several of these procedures, known as trephinations, done over several years (and under relatively primitive conditions). This is revealed by skulls, more than 12,000 years old, that have been found in North Africa and Ukraine with healed wound edges. Today’s craniotomy goes further still, and involves the patient in an operation on his or her open skull: more starting on page 22

TOURISM
Late romance
For millennia, nature was considered hostile. Nobody ever thought of bathing in the sea for fun, wandering across the moors, or climbing Alpine peaks. It was not until the end of the 18th century that the outdoors became the romantic destination of people escaping from the onset of industrialization. In 1786 the Frenchmen Jacques Balmat and Michel-Gabriel Paccard climbed Mont Blanc for the first time and in 1793 the first German Baltic resort (Heiligendamm) opened on the English model. Today, tourism in an industry in its own right. But nature is not always romantic, it sometimes bares its teeth:
more starting on page 32
PICTURES

See more than the human eye

The earliest black and white photographs took hours to expose; the first cameras did not see as well as the human eye. But in 1872, Eadweard Muybridge took the first ever high-speed shots of the racehorse ‘Occident’ in California, and in doing so proved that a galloping horse has all four legs in the air at a certain point. The camera had overtaken the eye.

Today’s film is a sensor that can produce an image of the environment even beyond that of visible light:

more starting on page 18

MUSEUM

Institution of muses

Mouseion: that was what the Greeks called the seat of the Muses, a place to reflect. From it developed collections, initially of curiosities, then later the Baroque ‘cabinets of wonder’ (such as the Grünes Gewölbe in Dresden), and afterwards places of collective remembering and instruction. The ‘Enlightenment Gallery’ at the British Museum, founded in 1753, brings together all of the meanings of the word in what is surely the mother of all museums. In 1794 the French founded the first ever museum of technology, a kind which today still has the power to explain and to attract.

The same applies to specialized museums such as this one in western Germany:

more starting on page 16

FORMER YUGOSLAVIA

Balkan tales

‘The land of the southern Slavs’ – that is how Yugoslavia translates. The amalgamation of independent kingdoms and parts of Austria-Hungary began from 1918 onwards, first as a kingdom in itself, whose internal and external tensions were temporarily covered over after the Second World War under Tito’s ‘Third Way’, only to emerge again after 1989. The capital was Belgrade: more starting on page 26

FILM

When pictures learned to run

The flicker-book offered the first ever experience of film, and already demonstrated the principle: individual images are shown so quickly in succession that they flowed into one scene when watched by the human eye. Initially an optical illusion for the funfair, after the development of photography it evolved into its own art-form – film. Audiences watching one of the first ever films in 1896, Arrival of a Train, shrank back in horror, so effective was the illusion.

The silent movie worked on that principle.

The Cabinet of Dr. Caligari, made in 1920, is considered a masterpiece of the genre, and as recently as 2014 was restored in a 75 minute version. In M (1931), one of the first German talking films, a blind man recognizes the murderer by the tune he whistles.

Snow White and the Seven Dwarfs brought color to film in 1937.

That of course requires props:

more starting on page 42

DONATIONS

Doing good helps the giver as well

One major reason for donating is, apparently, to be sure of your own identity: who you are to yourself and how you would like to be seen. That was what a team of academics at Stanford University discovered in 2009. But philanthropy helps others as well – anywhere in the world, and certainly in Cairo:

more starting on page 36
Welcome to the Greenhouse!

Deserts without oases, mountains without glaciers, polar bears without ice: CO₂ has been held responsible for many of the catastrophes relating to climate change in the modern age. But it is easy to forget that life would be difficult without this particular molecule – even PROTECTING THE CLIMATE would be difficult.
CO₂ for growth:
tomatoes as far as
the eye can see.
The Netherlands
supplies half of
Europe with these
tasty fruits

We love greenhouse gas!” This is a statement to which many people in the Dutch region of Westland might well subscribe. Situated between Rotterdam and The Hague, it is home to one of the world’s largest uninterrupted tracts of greenhouses. This is where they grow vegetables and decorative plants in glassy palaces the size of sports fields. Farmers here leave nothing to chance; even irrigation and fertilization are organized along industrial lines. Many of them switch on gas ovens even in summer - not to heat the greenhouses, but to supply the plants with carbon dioxide (CO₂), which is contained in the gas that the ovens produce. This is because without CO₂ there can be no photosynthesis, and without photosynthesis plants cannot grow. Plants use sunlight, water, and CO₂ to produce, by means of photosynthesis, oxygen, as well as the sugar molecules they need for growth.

Strictly speaking, fertilizing plants using gas ovens is enormously wasteful. Farmers are burning fossil fuels to produce a gas which elsewhere is considered a mass-waste, and which may contribute towards the ongoing warming of the Earth’s atmosphere. But in 1997 the production of CO₂ began to become more ecological and more economical. That was the year in which a large refinery was opened in the west of Rotterdam. The process of ‘cracking’ heavy hydrocarbons creates almost pure CO₂. Normal refineries simply pump this waste gas out through a chimney, but here it is transported to the greenhouses of Westland. And not a single truck is used in the process. In the 1960s a pipeline was laid past the greenhouses to pump oil from Rotterdam to Amsterdam, but it fell into disuse in the 1980s (see map on page 10). In 2005 it was resurrected for a project known as ‘Organic Carbon-dioxide for Assimilation in Plants’ (OCAP). OCAP is based on the idea of connecting CO₂ producers and consumers directly together.

A substance people want
OCAP is still growing in popularity - not least because gas prices have risen over recent years. A bio-ethanol plant was connected up to the network as a second CO₂ source in 2010. “This increased our supply capacity by a third to around 400,000 tons of CO₂ per year,” says OCAP Managing Director Jacob Limbeek. “In the medium term we expect demand to double.” But as far as protecting the climate in the Netherlands goes, OCAP has little more than a homeopathic effect. Even if the several hundred greenhouses were to use 800,000 tons of CO₂, that would only reduce the burden of the country’s carbon emission balance by 0.3 percent. Having said that, this project shows how greenhouses can be made much more eco-friendly.

The discovery has led to other climate-related projects. In the Zeeland province, as part of the ‘Warm’ pilot project, CO₂ greenhouses are being built in the vicinity of a fertilizer plant. There, CO₂ is created as a by-product of ammonia synthesis. Pipelines carry not only the gas to the greenhouses, but also heated cooling water that was used to cool the fertilizer system. As a result the greenhouses can be run in winter without the use of gas
CO₂ provides energy, can make everyday life easier, and can help slow global warming

> heating. Applications like this one help to protect the climate, and also go some way towards saving the reputation of carbon dioxide. The standing of this gas was severely damaged when people began to correlate the burning of fossil fuels and global warming. But people easily forget that human life would be awfully difficult without this molecule. It supplies energy, it can make everyday living easier, and in many ways it even helps to slow down global warming.

In chemical terms, CO₂ is a remarkably simple molecule consisting of one carbon atom and two oxygen atoms. In the forms in which it occurs physically, it behaves much like other everyday molecules such as water (H₂O). CO₂ changes between four different aggregate phases depending on ambient temperature and pressure. At normal atmospheric pressure and room temperature, CO₂ is a colorless and odorless gas. That is partly what makes it dangerous, since in high concentrations it can be deadly. Even professional emergency workers such as firefighters and other rescue operatives are not immune to it. But they can protect themselves; Dräger’s breathing systems and measurement equipment are one means of doing so. The human organism is one of the most active sources of CO₂ there is, because in its cells, carbohydrates, fats, and proteins are burned together with inhaled oxygen. This is a process by which energy is produced, and, when the body is at rest, between 10 and 20 liters of CO₂ are exhaled every hour. However, the quantity of CO₂ which escaped into the atmosphere in the year 2011 as a result of the burning of wood, coal, oil, and natural gas was around 20,000 times that exhaled by the world’s entire population during the same period.

Climate-changing reputation

In former times, CO₂, far from its current reputation as a climate changer, was respected as a means of healing. The Romans around 2,000 years ago used to bathe in sparkling water containing carbon dioxide to promote circulation. Science did not get involved with the substance until later. Johan Baptista van Helmont managed to isolate the molecule around 1600, and its chemical composition was discovered in 1780 by Antoine Laurent de Lavoisier. Half a century later, Michael Faraday succeeded in liquefying the gas for the first time. It was not possible to use CO₂ commercially until the middle of the 1950s, mainly because there was no way of transporting it. This changed when people worked out how to force CO₂ into pressure-proof steel cylinders in a liquid state. Today a large proportion of the consumption costs of the gas are incurred by logistics between the source and the consumer. The price of a ton of CO₂ doubles when it is delivered over a distance of 10 km.

OCAP: CO₂ to greenhouses

Greenhouses in the Netherlands have been supplied with CO₂ since 2002 in a project called ‘OCAP’ (Organic Carbon-dioxide for the Assimilation of Plants). To do this, the project tapped into economic and ecological sources and utilized, to a certain extent, existing pipelines. This is a system which is being expanded, and demand is expected to double in the medium term.
Tomato plants grow under controlled conditions on a substrate. They are irrigated and fertilized through pipes. Pollination, however, is done the traditional way – by bumblebees.
More than half of traded CO₂ ends up in the food industry

> around 300 kilometers. Despite this, the market for it grows by around five percent annually. According to Germany’s Industrial Gas Association, around 840,000 tons of CO₂ were sold in Germany in 2011; this figure was around three million tons for Europe as a whole.

Cleaning with CO₂

Around 70 percent of that amount ends up in the food industry. Food-makers use CO₂ to preserve and cool perishable goods and to carbonate drinks. A lesser demand - but one which is rising - comes from groundbreaking processes which use CO₂ for the solvent-free cleaning of metal tools, as an additive for diesel particle filters, and as a fertilizer in the production of biofuels (see box on page 14).

Industrially-used CO₂ was originally obtained exclusively from natural carbonated water springs, of which there are around 500 known examples in Germany. They are especially prevalent in the Eifel, the Central Rhine area, in Eastern Westphalia, on the Rhön, in Upper Franconia, and in the Swabian Alps. Nowadays however, large-scale chemical processes are almost the only adequate source of high-purity CO₂. One such process is the manufacturing of ammonia, an intermediate product in the manufacture of nitrogen fertilizer; another is the production of ethylene, which is used to make anti-freeze and cleaning agents; and yet another is the refining of oil. For many chemical companies, this product, which was once a waste product, has become a lucrative raw material which they sell to gas distributors. These distributors look for consumers who need CO₂, as well as profitable business ideas. Success, however, is far from guaranteed.

One example is the textile cleaning chain Fred Butler which was founded in 2006. Its business model was based on a patented cleaning procedure which used liquid CO₂ to clean clothing and shoes. As a dense medium made up of nonpolar molecules, liquid CO₂ can dissolve similar nonpolar substances such as oils and fats without the use of solvents. With the help of biodegradable additives, the cleaning capabilities of the liquid can be extended to other types of dirt. A washing cycle consumes less energy than conventional processes, since the washing fluid does not have to be heated up so much.

The plan was that by 2012, Fred Butler would operate around 200 dry-cleaning outlets across Europe. But it all came to nothing, because the technology, although innovative, did not become competitive quickly enough on the textile cleaning market, in which prices are hotly contested. Fred Butler has since disappeared from the scene. Even the best ideas need their own time to mature. 

Frank Grünberg

Pressure and temperature

CO₂ can change between four different aggregate phases, depending on ambient temperature and pressure:

- At atmospheric pressure, CO₂ is a colorless and odorless gas.
- If the temperature sinks below the ‘sublimation point’ of minus 78.5° Celsius, then the molecule transforms to its solid phase (‘dry ice’).
- At temperatures of above minus 56.6° Celsius and pressures of above 5.11 bar (‘triple point’), it changes into its liquid phase.
- The molecule reaches its ‘supercritical’ state at pressures of at least 73.8 bar, and temperature of at least 31.0° Celsius (‘critical point’).
Liquid carbon dioxide is also used to flash-freeze delicate foods. It cools the surrounding air in just a few seconds to below the freezing-point of water. This rapid cooling process leaves the water-content, nutrients and vitamins where they belong – in the product.
All-rounder in technical use

Grinding, freezing, cleaning: CO₂ has become a problem-solver in many applications – even in its 'supercritical' aggregate phase.

**CO₂: as a gas**

**Fertilizing:** plants grow by producing sugar molecules using sunlight, water, and CO₂ (photosynthesis). In greenhouses, CO₂ is often used as a fertilizer.

**Refreshing:** the soft drink industry enriches many products with CO₂. This sparkling gas has to have purity level of 99.5 percent for this type of use; no more than 1,000 gas particles may have a molecular structure different from that of CO₂. It is interesting to note that CO₂ is often equated with carbonic acid (H₂CO₃). The majority of the CO₂ is, however, physically dissolved, and chemically formed carbonic acid is only created in small quantities.

**Preserving:** perishable foods are sealed inside plastic films that enclose them in an atmosphere of CO₂ and nitrogen. This mixture of gases protects the goods against contact with chemically aggressive oxygen, and therefore against oxidation and decomposition. Carbon dioxide is harmless to humans in low quantities and within certain limits.

**Endoscopy:** in endoscopic examinations and operations, organs such as the intestine can be dilated by introducing CO₂ into them. This gives doctors a clear view.

**Neutralizing wastewater:** regulators demand that industrial wastewater has a pH of between 6.5 and 9.5 so that it can be fed into sewage systems or open waterways. Alkaline wastewater is often neutralized using slightly acidic CO₂.

**Treating drinking water:** a precise pH level is decisive in the quality of drinking water. It can be regulated accurately using CO₂, whether the water is too soft or too hard.

**Welding:** in the metal active gas process (welding), CO₂ protects the liquid metal beneath the electric arc against the oxidation that would result from oxygen in the air. This improves the quality of the weld, helps the dissipation of heat, and enriches the welded metal with carbon.

**Extinguishing fire:** CO₂ is a propellant and an extinguisher at the same time in gas fire extinguishers. In chemical terms it is very stable (inert), because it does not break down into its separate components until it reaches a temperature of around 1,600° Celsius. Since it is heavier than air, it suffocates the seat of the fire. But at the same time it is lighter than water, so it does not endanger the structure of a burning building, even in large quantities.

**… as a solid**

**Freezing:** solid CO₂ (dry ice) cools the surrounding air in just a few seconds to below the freezing point of water. Foods containing water can be frozen suddenly in this way (flash-freezing). This method of cooling is useful wherever it would be too difficult to operate a freezer, such as in an airplane cabin.

**Grinding:** ‘waterless’ plastics and metals become brittle at low temperatures, and lose their elasticity. The recycling industry makes use of this fact in order to separate out materials in electronics components that are being scrapped. Circuit boards are frozen using dry ice, then ground into granules, and sorted using magnets, sieves, and centrifuges.

**Blasting:** dry ice pellets fired at an object at the speed of sound have a multiple-cleaning effect on the object when they hit it. They remove dirt from the surface upon impact, and they also cool the area extremely fast, which creates a thermal tension between the surface and particles of dirt, allowing the dirt to peel off. The CO₂ pellets also dissolve oils and fats.

**… as a liquid**

**Washing:** in its liquid state, CO₂ is suitable as an energy-saving and eco-friendly cleaning agent for textiles and shoes (see also page 12; right-hand column).

**… in its supercritical aggregate phase**

**Refining:** in its supercritical state, CO₂ develops special chemical dissolving properties which allow certain constituents in herbs and spices to be extracted, and certain unwanted aromatic substances to be removed. In the production of light cigarettes, 95 percent of the nicotine in tobacco can be removed using supercritical CO₂. Similar degrees of effectiveness apply to the caffeine in coffee and tea. The advantage of high-pressure extraction is that the extracts do not contain any solvents or other residues.
Dry ice can be used to clean – in this case to remove a coat of paint at a shipyard. That is just one of the many uses of CO₂.
Examined Up Close

If you want to understand the essence of a subject, you need to know its history. The Horst-Stoeckel-Museum in Bonn, western Germany, shows the history of anesthesiology. It is science based, and as entertaining as it is informative.

The diagnosis: adolescent scoliosis – a permanent sideways bend in the spine. What that means is the young man now lying on his front on the operating table automatically looks out of the side window when he sits down in the driver’s seat of an automobile. In Bonn they can help him. In OR 2, a team of surgeons, anesthetists and other experts work to ensure that this eight-hour operation passes off without incident. “One of the jobs of the anesthetist,” says Professor Dr. med. Andreas Hoeft, Director of the Clinic of Anesthesiology at Bonn University Hospital, “is to safeguard the vital functions of the patient during the operation, to keep him alive.”

The numbing jar

Just a few hundred yards away his predecessor – in this post and as the head of his university department – points to a glass sphere filled with a sea sponge. “This is what it all started with,” says Professor Dr. med Dr. h.c. mult. Horst Stoeckel, showing off an original Morton Inhaler dated 1846. The device represents not only the beginning of modern anesthesia, but also the seed of the Horst-Stoeckel-Museum of the History of Anesthesiology in Bonn. Professor Stoeckel was given the ether inhaler during an international symposium in 1994 by his colleague Richard Kitz, who was in a sense the successor of its inventor, William Thomas Green Morton, who, on ‘Ether Day’ in Boston (October 16, 1846), first performed a successful ether anesthesia in public in front of invited dignitaries and students. It was the birth of modern anesthetics. Just how this developed, including its background, is told by the Museum in fascinating detail with almost a thousand exhibits. Professor Stoeckel first had the idea of converting his private collection of historical medical equipment into a museum on the history of anesthesiology in 1994 during the symposium – 18 months before his retirement. Born in 1930, the scientist had begun collecting medical devices during his training as a practical physician in the town of Marienberg in the Erzgebirge mountains of Germany. Some of them had been in use over several generations. His passion for the tangible

Museum founder with a passion: Professor Dr. med. Dr. h.c. mult. Horst Stoeckel
in Germany with a wealth of exhibits, many of them unique

history of his profession has remained with him throughout his career – when he studied at the Humboldt University in Berlin (which, after German reunification, awarded him an honorary doctorate); when he trained to be a specialist doctor at Berlin-Buch Hospital; when he moved over to West Germany and habilitated in 1969 in Heidelberg; and then finally when he moved to Bonn. There, in 1973/74, he was appointed to the newly founded Department of Anesthesiology, and together with a world-renowned group of researchers he dedicated himself for a full 20 years to what was then the new field of quantitative clinical-pharmacological research (including pharmacokinetics and pharmacodynamics).

It took five years of intensive work to convert the midwives’ and nurses’ home on Venusberg into what are now the spacious rooms in which the Museum and its permanent exhibition were opened in the year 2000. The exhibition is something akin to a flight through the entire history of anesthesiology. Stefan Dräger, Chairman of Drägerwerk Verwaltungs AG, called out to Professor Stoeckel during a talk marking the ten-year anniversary of the Museum: “You’ve got almost as many historical Dräger anesthetic devices here as we do in Lübeck!” And it was true: “Around a hundred Dräger devices, from the chloroform-oxygen device of 1902, to the first generation of the Zeus computer-controlled, integrated anesthesia workplace, dated 2002 – they illustrate 100 years of anesthesia in Germany, and, in their 15-meter-long display cabinet, demonstrate the company’s stand-out role in the field,” says Professor Stoeckel.

What differentiates this collection from many others is its scientific orientation. Visitors are enthralled by a Schimmelbusch’s mask, by perfectly preserved pioneer book publications, and even by a completely furnished operating room from around 1930; and, thanks to some clever arrangements, they are entertained by the international history of anesthesiology with all its convolutions and branches. “A normal tour through the Museum takes two hours,” says Professor Stoeckel. “If visitors are interested it can take four.”

The main processes of anesthesia
This would give you time to learn about the ten stations of the primary collection areas, presented in specially made display cases, as well as the developments that historical research underwent. Added to that are four special exhibits depicting in great depth the development of some of the main processes of anesthesia, from the early days all the way to modern routine use. Illustrated by exhibits and publications, these special exhibits show, for example, the development of laughing gas anesthesia and peridural anesthesia, examined up close. Also on show are some of the highlights of the 20-year scientific research under Professor Stoeckel at Bonn University Hospital, on subjects such as ‘EEG-controlled anesthesia-depth in a closed circuit’.

At the end of the tour, visitors feel enriched. As I leave I find myself wishing for a summary in which to read about everything again afterwards. “Don’t worry,” says Professor Stoeckel, reading my thoughts, and showing me briefly into his office. “I’m busy writing an overview of the permanent exhibition on the history of anesthesiology which I redesigned last year.” It is a history which, in its evolved phase, now enables extremely long operations like the one going on in OR 2 at Bonn University Hospital – to improve people’s lives.

Nils Schifffhauer
The inability to see anything in a precarious situation can limit the success of a rescue mission. A THERMAL IMAGING CAMERA can see even through darkness and smoke. The benefits of that are most obvious out in the field – during a training course in Sydney, Australia, for example.

Second Sight

The fun’s over, even for training: these men quickly forget that it is a carefully safeguarded exercise they are involved in. They are in their element, they sense the danger, and they practice life-saving techniques ready for real-life scenarios.

It isn’t just dark: Beyond the steel door lies total obscurity. On the other side, the smoke changes the air into an almost tangibly sticky mass. “Not being able to ‘see your hand in front of your face’ takes on a new meaning in there,” shouts a man in a protective suit through his respirator. Firemen rarely work in the glow of leaping flames. Usually, they rescue people from rooms that are pitch-
In addition to Athanas, a professional rescuer and trainer from the U.S., they are being helped by Dräger thermal imaging cameras.

**Dependable outlines**

Two chairs, a tricycle, a figure – the Dräger UCF 9000 films walls and objects in the room and renders their different temperatures as sharp outlines on the display. And the display is easy to see inside the dark structure of the mobile home. “At first glance, an infrared camera like this is a simple device with straightforward applications,” says Bob Athanas, who has been working as a firefighter for 30 years. But the technology is capable of much more. The device not only serves as a substitute for eyes blinded by thick smoke, but also peers around corners, senses temperatures, depicts thermal movements, and uncovers pockets of glowing embers. “After they take the course, the participants almost always come to the same conclusion: ‘I didn’t know I needed this training until I had it’,” says Athanas.

Comments like that keep him going. And so does knowing what the cameras can do. When correctly interpreted, their information not only saves the lives of fire victims but also makes the work of firefighters safer. In 1996, he established SAFE-IR, Inc., a mobile school that trains firefighters in America, Europe, Asia and – in this initial Dräger training session – in Australia too. “The camera can make our work more efficient in absolutely every situation, whether it’s in fires, during recovery of hazardous materials, or in other emergencies,” Athanas says. But the rescuers have to know their capabilities and must be able to interpret the data they provide without delay.

For hours now, Athanas has been setting fires, fanning them, and crawling through the hot container with each training group. Brett Storey and Cameron Wade kneel behind him on the concrete and work their way forward in the accustomed manner. Since smoke rises, it’s sometimes still possible to see things in the vicinity of the floor. There is a high probability that any possible victims are lying there too. The two men from Sydney’s Volunteer Fire Brigades breathe slowly behind their protective masks. They move forward carefully, feeling and hearing their way. Next, they take out their new “weapon”. The display shows temperatures of 80 °C, and even higher temperatures in one corner. Thermal movement in the left part of the room indicates a stairway in which the heat is rising as in a chimney. In front of them is an overturned cabinet; to the right is a sofa, and on the left is a piano. The thermal imaging camera translates infrared images into reliable outlines; it becomes a sixth sense, or a second sight. “A real eye-opener,” says Cameron Wade, when he breathes the fresh air again outside.

**Seeing movements in the heat**

“It’s not enough for us just to sell the technology. The users have to have a good command of it, try it out, and recognize its utility,” says Christian Ferris of Dräger. Ferris developed the seminars in Australia and supervised them together with Athanas in Perth, Melbourne, and Sydney.
“It’s fascinating to see how rescuers benefit from the device in emergencies,” he says. The Australian firefighter spent the first day of the course in the classroom. The members of the group are very diverse and have different levels of background knowledge: Chad and Tony from Canberra and two colleagues from Sydney have already worked with thermal imaging cameras. Some of the members from rural regions are trying them out for the first time. “To have a good command of them, you have to understand both theory and practice,” says Bob Athanas. “We talk about the basic principles and limits of imaging technology, and we study the features of different models.” The men take a close look at thermal layers and contrasts, study the movement of heat, and compare it with what’s on the display. They analyze color renderings and fluctuations in the measured values.

Some of the professional firemen have brought their own devices with them. That’s just fine with Athanas. For him, it’s not about specific brands. He wants to convey knowledge and teach skills, and he has a great wealth of experience. He also says what he thinks. That goes down well with the firemen. “I don’t have the feeling that someone wants to talk me into something,” says one of the participants. At the training site the next day, the firemen also learn about tactics, search techniques, and how to deal with hazardous materials. Naturally, even pros with the camera still need a good command of their rescue maneuvers, and they have to know safety drills and be able to perform a search without the device. “But as soon as they use the camera in the proper way, the result is simply more effective,” says Athanas. He describes it with a little humor: “It’s a tool that lets you cheat to a certain extent.”

Work is made safer …

The training continues in a darkened brick building. Refining tactics and techniques requires less exertion when the firemen can communicate without wearing the respirators. And thick smoke isn’t required to experience an “Aha!” moment. The men work in teams; one holds the camera and directs his partner through the room. “We used to grope through the darkness in parallel; we called out to each other about what we were touching.” The camera makes the work safer, quicker, and more thorough. And Athanas readily shares tricks used by the pros. In the long, dark

Eyes in the darkness

The Dräger thermal imaging cameras UCF 7000 and 9000 weigh 1.4 kilograms and can be hand-held easily and securely. Switches and buttons can be operated with a thumb. Additional operating modes can be activated, such as Fire, Victim Search, and Thermal Scan. The user can return to standard mode with the on/off switch. The cameras “see” in the infrared range at wavelengths between 7 μm and 14 μm and display the information on a 9-centimeter LCD monitor in black and white. The lens material is germanium — a semiconductor that is transparent to infrared radiation and thermally stable. The measurement range is -40 °C to +1,000 °C. The devices permit operating temperatures of -40 °C to +85 °C (inside the core of the camera). They can even withstand +150 °C for 20 minutes or +260 °C for 10 minutes. The UCF 7000 has a resolution of 160 x 120 pixels (2x zoom); the UCF 9000 has a resolution of 384 x 288 pixels (up to 4x zoom). The lithium-ion batteries last four hours on a charge.

In the past, frequent “stuttering” was a typical phenomenon in thermal imaging cameras. The image would stand still for a moment, as it does during switching, for example. This can cause blind spots that conceal dangers or persons. Dräger has dramatically reduced these stutter times. With a laser pointer, a fireman can direct his team members’ attention to hot spots or dangers. And thanks to the extended dynamic range, the cameras provide a clear image in spite of heat and clearly discern cooler objects even in the vicinity of flames. The UCF 7000 displays a 47° field of view (held horizontally); the UCF 9000 provides 57° horizontally, 41° vertically, or even 74° diagonally, and it offers not just a thermal image but also photo and video capture as a visual image, including playback on the display. It also has a thermal scan for the visual image camera. This makes it possible to match temperature thresholds of the visual image to the surroundings – that’s useful for quickly tracking down hot spots.
The container on the training grounds in Sydney’s Wahroonga district is scalding hot and smoking. Damian Eggleston of Dräger runs through the safety drills one more time with the firefighters before they try them out for real in the smoke. Interpreting the camera’s information accurately can save lives and make work safer.

corridor, he has Brett Storey turn the camera and hold it on its edge. The viewing angle of the display immediately increases, and in seconds it covers the ceiling and the floor too. “Very simple and very clever,” says the fireman with an approving nod.

“We often used to leave our camera in the truck until we had almost completely put out the fire,” says another. Only afterward did they use it to search for any pockets of embers they may have overlooked. This experienced rescuer has changed his mind, however: “From now on, we’ll wear the camera on our suits from the very beginning, and not just in closed rooms.” The infrared technology also makes it easier to discover victims and get a better idea of conditions during forest fires and in deployments invoking explosive materials.

…and more thorough

The teams from Canberra, Sydney, and the surrounding area compare Dräger’s UCF 7000 with the UCF 9000. They test various modes of operation and discuss their work and new ideas. The firefighters from Sydney, who both train new firefighters themselves, are thinking about how they can integrate the cameras into their instruction. “Of course, I’m not going to slap a device like this into the hands of a novice, someone who’s still struggling to get the adrenalin, heat, hose, and respirator under control,” says Bertoldi. His fellow firefighters nod in agreement. That sort of “baptism by fire” wouldn’t make much sense. “But as soon as someone has gained some self-confidence, you can start to use them – until it becomes a habit.”

A few weeks after the training course, Ferris gets a message from a course participants from Victoria: “On Saturday we saved a man’s life. Very thick black smoke (visibility: zero!); the camera was perfect the very first time it was used for searching. When I opened the bedroom door, I found the half-conscious man on the floor. If anyone has any doubts about the cameras, send him to me!”

Julica Jungehülsing

Information: Dräger thermal imaging cameras – design, function, uses. www.draeger.com/108/ucf
Awake in the OR

Ever since anesthesia has been around, patients have slept through their operations – normally. For this brain operation, however, it is better to wake them so that they can articulate.

Eighty-eight, eighty-five, eighty-two, …” Erich Müller counts backwards – a considerable achievement given the fact that he is lying on an operating table with a tennis ball-sized hole in his head, through which his exposed brain is being stimulated with electrical impulses. Müller hesitates. He can no longer talk. Neurosurgeon Dr. Michal Hlaváč, who is the Chief Physician at Günzburg District Hospital, continues with a procedure which, even worldwide, remains the exception rather than the rule: ‘awake craniotomy’, a brain operation which the patient cannot feel, but which leaves him awake enough at times to be able to talk to the OR team. Such a procedure becomes necessary when patients like Müller have a tumor in their brain which is situated near to the region which processes and produces speech. As long as Müller is awake and can calculate, or talk to the doctors about his life, they can see which of the convolutions – known as gyri – of his brain are responsible for speech, and which of them may not be touched during the operation.

Three weeks previously, Erich Müller had noticed on the way to the soccer stadium that something was not quite right. His right hand felt numb. When he tried to tell his brother what was happening, he couldn’t get a word out for a whole minute. “I wanted to say something but I couldn’t. Five minutes later it was all over.” He quickly looked in the rear-view mirror of his automobile to see whether the corners of his mouth looked distorted. As a first-aid assistant at his company, he had often seen the signs of impending stroke. But he could see nothing unusual about himself. A few days later he began to be unable to speak again and again during conversation. The following Monday he went to his family physician, and shortly afterwards was scanned by computer tomography. The doctors had soon identified a tumor called an astrocytoma.

Anesthetic brings anxieties to the surface

At Günzburg District Hospital, Müller is told by the Head Anesthetist Dr. Dirk Repkewitz why he has to be awake when the tumor is removed. “You will be asked to talk, and while you do so a team of neurophysiologists will use tiny electrical currents on the surface of your brain to find out which areas your speech center is in.” If an electrical impulse halts the flow of speech momentarily, or prevents Müller from speaking at all, then it indicates that they have found one of the speech-relevant regions, called Broca’s and Wernicke’s areas, which will then be marked and left alone when surgical incisions are made. Awake operations are rare in everyday clinical practice, and certainly something of a ‘thrill’ for an anesthetist, says Repkewitz. “I always have to keep a balanced dose so that the patient feels no pain, sleeps well, stays calm, and doesn’t panic – for several hours on end.” Not all patients are suitable for this. They have to be psychically stable. Repkewitz says he has no concerns about Müller, who the day before the operation behaved like someone going on a trip somewhere.

The electrical impulses used to stimulate the brain do themselves represent a certain risk. At Günzburg they have only once triggered one epileptic fit. “A difficult situation,” says the anesthetist, since the head is fixed in place during the operation. The female patient recovered quickly once Repkewitz had terminated the attack using a medicament, “But I would not like to experience that again.” At 8 am, Erich Müller is wheeled into the preparation room, wired up, infused, and his head shaved. ‘Patient 7923977’ is now staring at the ceiling. As the OR nurse asks him his weight and begins to chat to him a little, he appears to relax. Perhaps it is the anesthetic which is already coursing through his veins. Müller yawns and closes his eyes from time to time.

Instead of dropping off to sleep he begins to talk, as if to nobody: “You have to know what’s important in life – taking time for your family...” The anesthetic washes anxieties to the surface which yesterday had remained hidden behind a facade of fortitude and optimism. Dr. Repkewitz takes Müller’s hand and increases the dose. Müller sleeps, his chin drops...
Full concentration: the nine-man OR team works with intense focus – and the patient works also.

There is the brain: Every gyrus is numbered beforehand. During the operation it thinks and works with the team, and answers questions.
consultant, associate professor Dr. Ralph König, and a smile suggests itself behind his face-mask. “Which of course we are, but in this operation the team is the most important thing.” They perform together like an orchestra in which everyone knows how to play their part. “Awake operations are done quite often, aren’t they?” asks the patient suddenly, having just come around. “Yes, of course,” says Dr. Repkewitz soothingly; he has been holding his hand and his chin the whole time to stop him snoring, since that would inhibit his breathing. “Are you afraid, Mr. Müller?” No, not at all, answers the man bravely.

At 08:47 AM, the surgeon Dr. Hlaváč gives several large injections into the patient’s scalp. “Only the scalp, the muscles beneath it and the dura mater membrane are actually sensitive to pain,” explains Dr. König. The skull is fixed in a rigid holder. One reason for this is so that brain tissue is not damaged if the patient suddenly attempts to move his head during the operation. The other reason is to allow the computer-controlled microscope to synchronize MRI images of the position of the tumor with the position of the patient’s head in the operating room. A marking shows the surgeon exactly – to the millimeter – where the tumor is located.

Despite all this high-tech medicine, it is with a quite ordinary permanent marker that the shaved head is marked in the places where scalpel, drill and saw will later open the skull. One hour later, Dr. Hlaváč has sawn out a piece of skull about the size of a tennis ball. You can now see the membranes surrounding the brain. Before opening this final barrier to the brain, the surgeon changes his gloves. It is essential that bacteria and viruses do not find their way into the operating field. After that he reveals the white-glistening brain, criss-crossed with myriad branches of bright-red, pulsing capillaries, the whole thing like an oversized walnut.

At 10h03 Dr. Repkewitz wakes his patient by reducing the dose of propofol. “Mr. Müller, you are now waking up, please remain calm.” Neuropsychologist Evelyn Lanzar comes up close. Müller. Yesterday she had spoken to him about
his family, noted the names and birthdays of his grandchildren so that today, talking to him, she can see whether interfering with Müller’s brain will impair his memory, his speech, or his cognitive abilities. “Mr. Müller, please could you count backwards for me, ideally in steps of three starting from 100.” While Müller counts, the surgeon Dr. Hlaváč uses electrical impulses of first one then five milliamps to determine where the speech center lies. He has already numbered each convolution of the brain – literally, by placing small, sterilized digits from 1 to 12 onto them so that he can remember his way around.

When Dr. Hlaváč stimulates brain gyrus number four, the neuropsychologists measure spontaneous discharges long after the impulse has finished. An epileptic fit is imminent and the team is alarmed. “Mr. Müller, do you feel alright?” asks the surgeon; “Do you have a headache?” But Müller can say no more than “Hmmm.” The neurophysiologist warns: “It’s spreading...” and Dr. Hlaváč, the surgeon, attempts to stop the seizure by rinsing the brain with an ice-cold saline solution. The surgeons are able to prevent the seizure, but it is a good quarter of an hour before Müller can say his own name again. The doctors decide to stop stimulation, and brain gyri 1 to 4 are no-go areas from now on. However careful he is, Dr. Hlaváč cannot remove the tumor without damaging intact brain tissue. Dr. König is convinced that there is no such thing as brain tissue without a function. “The question is, how do you determine the function of an area of the brain?” If you test speech and movement during and after the operation, then the patient will in all likelihood seem completely healthy and normal. “But things can look different if you examine the patient for things like memory defects.” For this reason, the French neurosurgeon Hugues Duffau performs certain tests to assess brain function not only when operating on the speech center, but also on other areas of the brain which could be endangered by a procedure. In some cases, however, the changes after the operation are very subtle and cannot be detected at all by testing.

When speech falters

The tumor has now been revealed. Instead of the white, orderly nerve cells, pale-gray, blister-like, unstructured tissue appears. A good hour has passed by the time the walnut-sized tumor has been sucked away. Dr. Hlaváč then runs into a barrier: the moment the surgeon attempts to suck up the surrounding tissue, which is usually infiltrated by tumor cells, Müller’s chatty speech falters. Dr. Hlaváč has come too close to the speech center. Just as he is about to continue using a more gentle ultrasound suction device, the results of a quick analysis of the tumor-tissue come back from the laboratory. That which the surgeon had already suspected on account of the tumor’s appearance is now confirmed: the astrocytoma is in an advanced stage and therefore incurable. Hlaváč now talks very quietly. They do not want to confront the patient with a diagnosis which probably gives him no more than 12 to 24 months to live. From now on, complete resection of the tumor is no longer the top priority, since the more radical the resection, the more likely it is to cause neurological damage, says König. “Patients with neurological damage generally suffer impairments that cancel out any increased likelihood they would have had of surviving, given a total resection.”

The mood in the team is glum. Müller is inserted into the MRI scanner once again to take pictures of his freshly operated head and make sure that no removable tumor tissue remains. The rest, the ‘closing-up’, is routine work. Dr. Dirk Repkewitz wheels his patient into the wake-up room. Müller breathes peacefully. He seems to be asleep. As Dr Repkewitz speaks to him and asks him whether he is well, his eyes snap open as if the doctor had switched him on. “Yes,” says Müller, as though he himself is asking the question.

Sascha Karberg
Olivera Veličkovič, physiotherapist: “Therapy based on Bobath fosters preterm development”
With a Clenched Fist

How do doctors in Serbia help preterms to survive and grow? Media company B92 worked together with the **INSTITUTE OF NEONATOLOGY IN BELGRADE** and came up with a convincing answer – a concept that has attracted interest and gained recognition internationally.

Maja weighs a mere 1,100 grams, and her tiny arms and legs are painfully thin. She has spent the first few weeks of her life in an incubator, artificially fed and ventilated. “At birth she weighed only half as much,” says the pediatrician Dr. Miroslava Kostić Todorović, who heads the Neonatal Intensive Care Unit (NICU) at the Institute of Neonatology in the Serbian capital, Belgrade. “I feel a personal responsibility for every premature baby here – just as though they were the children of close friends.” Yet not as though they were her own? “Oh, no! I can’t afford to get that involved. We can help these babies only if we keep a professional distance.”

And this help is vital – both for the preemies themselves and for their parents.

“Until recently, preterm births were a neglected subject in Serbia,” explains Dr. Milica Ranković Janevski, Director of the Institute of Neonatology, which is located in a 1925 building right in the middle of Belgrade. With a population of two million, this is the largest city in the Balkan republic, which was founded as a state as long ago as 1835. Since then Serbia has been through turbulent times, most recently with the country’s painful rebirth during the breakup of former Yugoslavia, which was followed by bitter fighting, a period of international isolation, and, directly afterwards, an economic crisis.

**Top facility for neonatal care**

With a per capita gross domestic product that is 11,085 U.S. dollars (2013) and rising (adjusted for purchasing power parity), the Republic of Serbia, with its seven million inhabitants, is ranked 86th of 186 countries by the International Monetary Fund (IMF). The economic situation is precarious. A pediatric nurse with a bachelor’s degree who is working shifts earns little more than 500 euros a month, while a pediatrician will rarely top 1,200 euros a month. Rents, particularly in Belgrade, are on a level with those in Berlin, and the cost of living is only marginally lower.

Yet in spite of these challenges, there is little sign of lethargy, least of all in the “Institut za neonatologiju”, which is affiliated with the medical faculty of the University of Belgrade. Here, as everywhere, there is a keen sense of purpose. “We’ve quickly become one of the top facilities for neonatal care in the Balkans, >
After the uncertainty, parents’ joy is indescribable when they see their preterm

> providing an international standard of care,” says an institute spokesman.

**Persistence pays off**

The “Battle for Babies” campaign (in Serbian called: “Bitka za bebe”) was coordinated by B92, one of the region’s leading broadcasters, with TV and radio channels, and an Internet presence. Despite everything, including being banned a total of four times, B92 has managed to remain independent and liberal. “We regularly run campaigns to help disadvantaged people in our country,” explains the broadcaster’s bear-like director, Veran Matić. And once Matić gets his teeth into something, he sees it through with a mixture of grit and good contacts. His great specialty is mobilizing people. “Preemies might not have a lobby, but they still need professional care to ensure that they develop like everyone else,” he says.

Matić, who is himself a father, was particularly inspired by the story of the German pedagogue Silke Mader. She gave birth to twins, via emergency Caesarean section, in the 25th week of her pregnancy, to Lukas, who weighed 500 grams, and Lena, who weighed a mere 300 grams. Only Lukas – who is a lively teenager today – survived.

Mader subsequently set up the European Foundation for the Care of Newborn Infants (EFCNI). The purpose of the foundation – a pan-European organization based in Munich – is to work together with scientists and doctors to systematically improve the survival chances of preterm infants.

A review of the neonatal facilities in Serbia showed that professional care was available only on a very fragmentary basis. Any significant improvement in survival rates would require system-
infant grow into a healthy child

From a financial point of view, the biggest challenge was the need for incubators, vital pieces of equipment which provide a controlled environment, at a precise temperature and humidity, in which preterm infants can be monitored and cared for. In addition, it was necessary to provide the requisite infrastructure and ensure the introduction of modern treatment methods.

In the end it was decided to centralize the care of preterm infants at the Institute of Neonatology in Belgrade. This necessitated the establishment of a transport service in specially equipped ambulances from anywhere within Serbia—a journey that can take up to six hours. At the same time, modern standards of care were implemented in the neonatal wards.

“We opted for the integrated NIDCAP concept,” says Preterm Clinic Director Janevski. NIDCAP stands for “Newborn Individualized Developmental Care and Assessment Program,” and it enables preterm infants to continue their (prematurely interrupted) development in the world outside the womb. The focus of this concept is not exclusively on survival but also on mitigating as much as possible the physical, mental, and sensory deficiencies that inevitably occur as a result of a premature birth.

A professional campaign

This concept demands a highly dedicated approach from the team of doctors, nurses, physiotherapists, and social workers at the institute, who now treat around 4,000 preterm infants every year. “The most needy of all,” as Dr. Ranković Janevski calls them, have to be cared for in incubators.

In Serbia, however, these vital items of equipment were all around 40 years old. As a result, the mortality rate among...
Highly trained and dedicated professionals committed to providing preterm

> preterm infants with a birth weight of 999 grams was 60 percent compared to 15 percent in western Europe and the U.S. One of the key aims of the “Bitka za bebe” campaign was therefore to raise funds for at least 100 incubators.

The campaign was developed by Saatchi & Saatchi, a heavyweight from the international advertising world. The agency’s office in Belgrade donated its services free of charge, and the broadcaster B92 provided free airtime and PR. It’s no secret that their involvement also brought both of them some excellent publicity. Saatchi & Saatchi, for example, was honored with a stack of awards, from Sophia to Moscow, for its “Bitka za bebe” campaign.

Yet such recognition is by no means undeserved. The Belgrade agency devised a campaign that really touched the emotional core of this topic. “When you see a preemie in an incubator, you know that it is fighting for its life,” says B92 director Matić. This was the idea behind the stark, martial imagery of the campaign, which exhorted the public to join the struggle.

The image of the tiny clenched fist was a reference both to the final phase of the “Moro reflex” in all newborn infants and to the universal symbol of struggle. The fact that this emblem was also used by the opposition to the regime of Slobodan Milošević—a opposition that also enjoyed the support of B92—was a happy coincidence.

Human milk bank

The “Bitka za bebe” campaign took a novel but highly efficient approach toward fundraising. “We wanted to mobilize people for the campaign, without asking them to donate any money,” explains Sonja Milović, Director of Saatchi & Saatchi Belgrade. Instead, it was hoped that people would encourage companies
infants with a better start in life

Zorica Cvetanović, pediatric nurse: “Preterm infants are placed skin-to-skin on the mother’s chest as early as possible”

To contribute toward the incubators. The success of the campaign surprised even the most optimistic observers. The initial target of 100 incubators was rapidly reached, and within a year more than 190 had been funded. Dozens of these are now lined up in one of the wards at the Institute of Neonatology. Here the newborns receive initial care: ventilation, artificial feeding via nasogastric tube with breast milk from the institute’s own human milk bank, monitoring of all vital bodily functions, and individualized care. “It’s not enough just to look at the baby’s weight and then work through a routine,” explains Dr. Kostić Todorović as she bends over Maja’s tiny body. “Each infant reacts in a different way and requires strict monitoring and individualized care.”

It can be difficult to determine just what that care should be, particularly when preterm infants arrive from maternity clinics around the country accompanied only by patchy data on their condition. At the institute, they are examined by a pediatrician before being placed in an incubator where they will make up for the time they should have spent in the womb. Even at his stage, however, their parents can visit them every afternoon. Once a premature baby can breathe without external assistance, the next phase of NIDCAP begins. This may involve a procedure known as kangaroo care or “kangarooing.”

“Here, the baby lies skin-to-skin on the mother’s chest and visual contact is maintained using a hand mirror,” explains Zorica Cvetanović, who is a pediatric nurse. In the next room, the physiotherapist Olivera Veličković cradles the tiny head of preemie Ilka between her hands: “This is a therapy based on the Bobath concept. We use the plasticity of the baby’s brain to develop its perception of its own body and to build up its muscles. Some of the preemies here will soon be ready for discharge.”

Medals for a preemie

For preterm infants who cannot return to their own families, the social worker looks for foster parents. They too, like all preemie parents, receive a thorough grounding in the subject, so that their children have the best possible chance to make up for any delayed development. “That’s Velijka – he weighed 1,120 grams at birth,” says Dr. Kostić Todorović, pointing at a photo of a teenager in swimming trunks. “He took up swimming at the age of seven and has since won a lot of medals in competitions.” He’s another one who knows what it means to fight for his life.

For more information
► European Foundation for the Care of Newborn Infants: www.efcni.org
► Online petition to improve care and family support for preterm infants: www.enemenemini.eu
Saving lives on the Matterhorn

Thousands of amateur alpinists swarm to the Swiss Alps every year – and they often underestimate THE DANGERS that cold, wind, and quickly changing conditions can bring.

Susi, depart immediately!” Men who had been reading the paper, drinking coffee, or snoozing, are immediately standing ready. They do not seem ruffled, but instead pursue their routine determinedly. “Everything which we are able to plan is precisely defined,” explains Professor Dr. med. Volker Lischke, duty physician in the three-man rescue team working this March weekend by Air Zermatt. “But we always have to improvise a lot on our missions into the mountains.”

In the Himalayas too

‘Susi’, a Bell 429 helicopter, rises powerfully into the sky. A skier has fallen and is unconscious; every minute now counts. The weather does not look bad: blue skies, glistening snow, but a strong wind is blowing up the valley at whose end Zermatt is tucked onto the slopes of the mountains of the Upper Valais. The town lies at an altitude of 1,800 meters, surrounded by the Matterhorn and 29 other four-thousander-meter peaks. The heliport is at the valley-end of the ski resort which, in winter, is populated by amateur alpinists from all over the world, and in summer by climbing enthusiasts and extreme mountaineers. Soon after the emergency call, the rescue team is sitting strapped into the helicopter. There are three men: pilot Daniel Aufdenblatten, recipient of the Heroism Award for what was at the time a unique rescue operation at 7,000 meters in the Annapurna region of Nepal; Professor Lischke, the doctor, who was a mountain rescue worker before he studied medicine. He is involved in training mountain rescue teams and has also published research papers on the subject. Then there is paramedic Günther Willisch who leads the paramedic personnel at Air Zermatt. All of them are well accustomed to this high-altitude work, where oxygen is scarce and medicines can work differently.

They are now on their way to the casualty, knowing only the piste on which the
The helicopter is often just the first stage, after that they go by foot.

Skis mark the place where the accident happened.

Deceptive idyll: Air Zermatt’s helicopter missions, sometimes over glaciers and by cliffs, are not without their risks.
Altitude and shimmering air are a challenge for crews and equipment

> accident occurred. When they arrive, Aufdenblatten scans the ski slope from the helicopter. Skiers wave up to them, pointing towards the mountain. When the injured skier comes into view, the piste has already been closed off using crossed skis. The helicopter lands nearby. On this occasion W illisch and Lischke can simply climb out without abseiling, even though they had put on the harnesses to do so before they got in. While the two of them take care of the fallen skier the helicopter lifts off again so that it does not present an unexpected obstacle to the many skiers. Once the patient has been prepared for transport, he lands back next to the piste. Snow flurries up and the men have to hold tight to the rescue equipment, showing just what forces are involved.

Intensive care at a giddy height

Air Zermatt performed more than 1,600 such missions last year. Some of the team are called out on rescue missions, others head up medical facilities and coach students; it matters not. What is important is expertise, years of experience, and a willingness to give everything to save lives. The founder of Air Zermatt is himself something of an idealist: Beat H. Perren, at the ripe old age of 81, still stands in his pharmacy in the town, recalling the early days. “The train driver used to have to look for fallen mountaineers and bring them down into the valley. There was no road, and that cost valuable time.” There was a rescue helicopter in the Lower Valais, but if the weather was bad it could not reach Zermatt. The first rescue mission involving a Zermatt-based helicopter was flown in 1968. Beat H. Perren was an air rescue worker back then. Since then, the helicopters of Air Zermatt have performed a lot of pioneering work. They were the first to use a rescue winch, which quickly established itself as indispensable in the mountains. The reward for this work is that today Air Zermatt performs the majority of all Swiss mountain rescue operations above a level of 3,000 meters.

The demands on personnel and equipment are high. The sheer physics of flying can be challenging. At these altitudes, the air is thinner and does not carry a helicopter so well. Shimmering summer air may promise a fantastic day out for tourists, but for helicopter crews it can mean turbulence. “In the mountains it is always too cold, too warm, too dry, or too wet. It is something of an art, adapting medicine to such situations, and especially bringing intensive care medicine to the mountains,” says Professor Lischke of his work in the Alps. “There are enough imponderables, and that is why everything which we can influence has to be just right.” That includes experienced pilots and a dependable team, as well as proximity to the place of work, and suitable equipment for the mountains.

As well as the rescue team, ground staff contribute to the success of Air Zermatt. Every helicopter, in a regular cycle of flying-hours, is dismantled completely and checked carefully, component by component. “We even sand off the paint,” says one of the flight mechanics. The fact that the rescue workers are near to their place of work saves valuable time and even lives. Modern intensive medicine is more successful if performed quickly. And the helicopter is in a sense a ‘miniature intensive care ward’ containing mobile resuscitation, monitoring, and emergency breathing systems. This equipment has to be robust. It has to deal with

A crew of three you can rely on: lifesavers Francis Schwery and Andreas Haug (photo left) and Professor Dr. med. Volker Lischke
rapid changes in temperature and altitude without losing its ability to work, and must function reliably even under extreme situations. Air Zermatt’s Bell 429 can fly at night and can fly blind. For rescue workers that means everything which they reach for in the daylight has to be within reach at night as well. Air Zermatt’s founder Perren believes that its proximity to the rescue regions is equally important: “We will gladly help anybody – except those who prefer the silence of the grave to the sound of a helicopter!” Zermatt is a car-free town, except from electric vehicles. You can see the postman and the local police motoring silently around the little town along with the rest of the inhabitants, who number less than 6,000. Touring, rescue, and heliskiing flights, however, are easy to hear. The four-thousanders around Zermatt are the capital of the region and attract tourists and adventurers almost magically. Some of them are not aware of the risks of the Alps. The very first time the Matterhorn was climbed, in 1865, four of the seven-man roped party fell to their deaths. Perren himself remembers a young Belgian woman who fell into a glacier crevasse some years back. “The heat of the body immediately melts the surrounding ice – you can slip out of sight incredibly quickly, and you chill quickly too.” There was a rescue helicopter by that time. “But although mountain rescue workers were lowered head-first into the crevasse, they didn’t manage to free the girl. We were only able to retrieve her dead body.”

This tragic accident was the thing that finally prompted him to search hard for new rescue methods. Many of the things he tried did not work, but the balance at the end of the day is a respectable one. The number of mountaineers who have Perren and his colleagues to thank for their lives is considerable. Much of the rescue equipment developed in Zermatt is now standard-issue throughout the world, says Perren.

**Little thanks – but lots of meaning**

During the early years of the company, in 1973, helicopter rescue in Switzerland was ‘medicalized’ by Air Zermatt. This meant that permanently employed physicians and paramedics accompanied the crews on their missions. In the middle of the 1980s, experience in emergency and intensive care medicine were also made a prerequisite. Nowadays well trained doctors, including two professors, come to Zermatt for two weeks of the year, during their vacations. Their work in hospitals, and often their research, means they tend to be abreast of the latest developments. Sophisticated equipment assists them in their work. Included on board is a Dräger emergency ventilator, the Oxylog 3000 plus. Professor Lischke values its presence on his missions. “Its control knob is unbeatably simple and allows you to set the most important parameters accurately.” This weekend, the four rescue helicopters belonging to Air Zermatt flew well over 20 missions.

The forgetfulness of the people they rescue can sometimes seem incongruous; they seldom receive thanks, even in matters of life and death. But there can be few professions which offer more meaning than that which these people experience.

Dr. Ulrike Novotny
Hospital 57357

One of Egypt’s most modern hospitals was built from donations alone. Its operators aimed for **FREE TREATMENT** from the beginning. It is a project which is having a big effect.

This is a sight you otherwise only see at the pyramids of Giza. There are many people coming and going outside this building in Cairo. They point at the glassy sails and glazed dome. Like tourists they hold up their mobile phones and snap shots of the glistening building. But these people are not sightseeing. Parents push their children along in wheelchairs in front of them, while nurses spend a few minutes out in the fresh air with patients whose health allows it.

Many of the fathers wear the jalabiyya, a traditional, flowing men’s cloak. Most of the mothers wear a headscarf and an abaya, which is a loose black garment. They come from the countryside or from the poorer districts of Cairo. A hospital like this, which comes across almost like a five-star hotel, is something they have never before entered; they could never have afforded it.

**Open-minded**

The complex of buildings houses Egypt’s only children’s cancer hospital, which is one of the most advanced facilities of its kind in the Near and Middle East. What is special about it is that it is financed entirely through donations. That in itself is a minor miracle in a country which basically needs voluntary help everywhere to alleviate people’s suffering. The hospital’s high standards do not come cheap: annually they require 100 million Egyptian pounds, around 12 million euros. Businesspeople, companies, and organizations contribute large sums, yet 80 percent of all donations is made up of amounts of less than 100 pounds, which is around ten euros. That too is a miracle, since this money comes from people who often cannot make ends meet themselves. Khaled El Noury is one of the deputy directors of the hospital, and he is responsible for the infrastructure. He explains how the glass globe above the entrance area symbolizes open-mindedness, and the sail made of glass is reminiscent of a felucca, one of the sailing boats on the Nile. “The patients who come here embark on a journey whose destination is survival.”

El Noury is a perfectionist. He loves details and points out the corner between the floor and the wall: “It’s rounded like all of the rest of them in this hospital,” he says. “It means that dirt doesn’t get stuck there and it’s easier to clean.” That may appear a secondary detail, not one that
Around one working month each year is spent on continuous training by nurses

Goodly souls

Eighteen-year-old Mona has had a brain tumor removed at the hospital. She now lies in the ward, bravely putting up with chemotherapy. She says something quite remarkable for an Egyptian hospital patient: “During the day I like best to go to the Maktaba and talk with Sister Mona.” The namesake nurse is a sort of friend of hers in the hospital. She takes time to listen, and here there is nothing unusual about that. At other hospitals in Egypt, parents have to buy such attentions with little gifts and baksheesh. There is a Maktaba on every floor. It is a library housing books, toys, and computers with Internet access. There are also school classes there, allowing patients to keep up not only with curricula but also with life itself. “The children have to be able to look forward to the future,” says El Noury. “If you’re still preparing for that, then you have not given up.”

Mona seems weak. Her face is pale yet her eyes are bright despite the disease which is eating away at her. She says she doesn’t like the food at the moment and smiles, saying she doesn’t like eating very much anyway. Her family comes from Aswan, right in the south of the country. “We expected the same conditions here as in other Egyptian hospitals,” explains her mother. “But the style here is quite different. The staff are goodly souls.” The family lives in Cairo. Her father works as an engineer at a building company. He comes for a while every day, says Mona, despite the three hours of travelling involved. Mother stays in Mona’s room around the clock. She spends the night on a reclining chair next to her sick-bed. Mona’s parents noticed there was something wrong with her when she began to experience balance difficulties. The doctor diagnosed a brain tumor and asked the parents to tell their daughter when they were alone with her. “I simply cried when I found out,” remembers Mona. “But I only cried because my mother was crying.”

Dr. Wael Zekri, one of the hospital’s oncologists, finds it easier to deal with the heavy fate of child cancer-sufferers than he does with adults. Children, he says, are rarely alone. Unlike adults they almost always have relatives to look after them and console them. But it upsets him that such a large number of children suffer from cancer in Egypt. On a global average, 2.5 of every 100 cancer patients are minors, but in Egypt the figure is around four times higher. Some blame that on environmental contamination and the heavy use of chemicals in agriculture, but that remains a con-
A four-year-old on the way to recovery

Controversial explanation. The population, after all, is unusually young - almost half of Egyptians are under 20 years of age.

On the wall of the doctor’s consulting room hangs a board with several hundred photos on it. They show children he has treated. Many of them are smiling. But some of the pictures are marked with a black dot. “These children,” says Dr. Wael Zekri with a distant look, “didn’t make it.” Dr. Zekri is one of 150 physicians at the children’s cancer hospital. Half of all the patients come from the Nile Delta or from Upper Egypt, 40 percent of them live in Greater Cairo. 1,300 children are treated each year in 180 beds, and over 5,000 as out-patients. The capacity of the hospital is sufficient for only a quarter of all the child cancer sufferers in the country. One in two children has to be turned away.

A hospital which aims to save so many lives has to operate like clockwork. Its in-house apothecary provides 60,000 tubes of chemotherapy each month. Patients wear badges marked with a barcode. Any member of staff who scans this barcode can access the patient’s digital file and can allocate each medicament precisely to the patient for whom it is intended. Digital data flows between physicians, nurses, and therapists, and all the way to the hospital’s own research department with its 25 scientists and laboratory technicians.

Certified

The hospital’s social services department also uses this data to decide more effectively which families require what support. Many of the children come from >
Around 50 employees work using the latest fundraising methods. “You can donate digitally,” says Myra Doss, using the website, credit card, SMS or phone. The Egyptian woman manages the Publications department. On a tour of the hospital she points out the many little signs showing the names of people and institutions who have paid for an elevator, an operating theatre, or a chair.

Revolution and future
The hospital became a national charitable project with which many Egyptians can identify and of which they are proud. When the news spread during the revolution on January 28, 2011 that a mob was moving towards the hospital to plunder it, citizens rushed to protect the building. “Even butchers and slaughtermen from the neighboring district came running,” says Khaled El Noury, “to defend the hospital with knives and axes.” The hospital and its glassy sails remained intact – the hospital which many cancer-suffering children in Egypt cannot live without. Since the hospital has been in existence, around 80 percent of all child cancer victims in the country survive the first five years from the start of treatment. Previously this figure was just 40 percent.

Eighteen-year-old Mona, who had a brain tumor removed here in the hospital, is already making plans for the future. She wishes to study agriculture, and then to help save other children from her fate. Mona would like to be involved in research projects that aim to significantly reduce the use of pesticides in farming.

Jürgen Stryjak
Searching for Values

Dräger has been sending its employees to SWEDEN’S WILDERNESS for the past 30 years to help them gain more courage, trust, and assertiveness.

The weather is wild. Waves on Stora Gla, one of the two big lakes, are making the canoes rock like corks on ocean waves. It is too late to follow the suggestions of the four-man team of coaches: “Stay as near to the bank as you can and don’t go out into the lake!” That is exactly where the twelve canoes now are. They are being lashed by a strong wind. Stora Gla, which had looked so easy to cross a little while ago, has turned angry and is sending one wave-front after the other onto the boats. They are being lashed by a strong wind. Stora Gla, which had looked so easy to cross a little while ago, has turned angry and is sending one wave-front after the other onto the boats. Arms are hurting. They have little strength left to steer against the wind and prevent a canoe from being caught side-on by a wave. Yet by joining forces they manage the crossing in the end. But then the landing does not go well; it is confused and lacks any real team spirit.

“Mutual support does not look like that!” calls out one of the coaches. Two hours and a few discussions later, sitting around the crackling campfire, the failed lake-crossing is almost forgotten; it has transformed into a beautiful, wild memory.

Companies from all over the world send their workers and managers into the wilderness in order to gain this kind of knowledge. This particular program, called ‘Wilderness Experience’ has been a part of Dräger’s corporate culture for more than 30 years. “It is considerably more comprehensive than other comparable outdoor training courses,” says Imke Ubben, Human Resources Manager at the Lübeck technology group.

Journey into the self
The nine-day trip is held in intentionally faraway places. Here in the Glaskogen Nature Reserve in the Swedish province of Värmland, the 20 international trainees, led by their coaches, must ascend steep cliffs, cross gorges suspended from ropes, and cross countless lakes, large and small, in canoes. Often they must do without the comforts they are used to, such as contact with the outside world, a roof over their heads, and regular mealtimes.

Daily activities in the group are always out of doors, and all of the tasks they are given can only be completed in a team. The idea is that the experiences they go through together encourage the workers to foster collaboration in their everyday working lives, both inside and outside the company, and to develop themselves and reflect regularly on their own behavior. “Nothing,” according to Imke Ubben, “bonds people together more than shared experiences.” That is why many consider Schleiftraining to be of greater educational value than conventional seminars. You can of course attend a three-day event, but what you are taught in it is often quickly forgotten. “Practical experience and the combining of its different modules are what make this program so unique,” says Ubben. “Leaving the comfort zone, having completely new experiences, and getting feedback regularly – not all of that is easy.” It is only the final polishing that makes a diamond shine. That is why every candidate must also practice an individual discipline for 24 hours. It is a kind of ‘journey into the self’. And from it, every participant has so far emerged stronger. “People’s priority of values has changed,” explains one candidate. Humility used to be considered a high virtue, then it lost people’s interest. Today, searching for values is emerging once again.

Björn Wölke
The Cabinet of Shai Sinai

Medical MOVIES AND TELEVISION SERIES are in vogue. And if they are set in Germany, much of the technical equipment featured in them will likely come from Film Ambulanz Hamburg – a store of props which is as rich in associations as many classic movies.

Even Cloud Atlas features something from here: “Tom Hanks, who plays a doctor (among other things), does so using one of my pipettes,” smiles Shai Sinai, surrounded by his stock of around a million props from the field of medicine. Ranging from a modeled amputated finger to a giant computer-assisted tomography ring, they are stored in the 400-square-meter premises of his Film Ambulanz Hamburg. Does he have an inventory of them all? Sinai taps the side of his forehead: “Yes, here!” It’s all up there: equipment for films like Medicus and The White Ribbon, for TV series like Grey’s Anatomy, Tatort, Einsatz in Hamburg and others, but also for videos advertising auto manufacturers, insurance companies, logistics businesses, and many other companies besides.

Medical family tradition

But all of it somehow relates to medicine. It relates to children’s hospitals; it relates to operating rooms – which he equips with anesthesia systems, OR lights, and medical gas supply systems (including ones made by Dräger) – and it relates to pharmacies, which he sets up from his fund of equipment spanning centuries.

Strolling through the collection, Sinai reaches enthusiastically for a catalog of surgical equipment from around 1900: “I use reference works like this to inform myself so that I can put together the right historical equipment for a production. There are experts out there, in cinema seats and on couches too, who are looking out for mixed-up eras in movies!”

The prop man keeps his most valued treasures carefully under glass. Take for example his set of eerie glass eyes. But where does this passion come from – this passion for props, but also for this particular niche? Sinai opens a stuffed-full pouch to reveal a plethora of bandage scissors, tweezers, and even a thermometer in a leather case. His father always carried the same leather case in his tunic pocket. Was he a physician? “Not really,”

Wander on in! Props hang and stand around even in the corridor on the first floor of a northern German factory hall

PHOTOS: NILS SCHIFFBAUER (3), X VERLEIH AG (2), ABC, ARD/GEORGES PAULY, FOTOLIA
admits Shai Sinai, showing me a pho to on the wall showing a German field hospital in the First World War, in which serious looking men tend to a wounded soldier. “That’s my great-uncle Harry Moses,” he says, pointing to one of the doctors, “My father learned everything by watching him.” Born in 1918, his father had to emigrate from Germany in 1934 together with his family, and took little more than a first aid bag with him. That, and the experience he had soaked up from his uncle, made him a paramedic and a doctor.

This medical family tradition manifested somewhat differently in the son. School, three years of army, and then on to Alaska. His girlfriend came from Hamburg and he returned to Germany with her and learned German, worked as a tradesman, and adopted German citizenship.

“Professionally I was without direction,” he says, “until, in 1987, I did a practical training course as a prop man for a German medical series. I loved it.” And it wasn’t just on that set, it involved many other projects in which he was soon taking care of everything, from in-house to general prop acquisition. When the opportunity to set up his own business in prop rentals offered itself in 2005, he took it. “I get the things from everywhere,” he adds, showing us equipment from a medical practice which operated in Berlin between 1920 and 1960. Then there are the hundreds of instruments from a medical supply store which had to make way for a bank in Hamburg. Hospitals call him when they modernize or close down departments. Manufacturers give him exhibits which would otherwise be scrapped. “Product placement can play role, but so do good relations,” he says as we pass an iron lung made by Dräger in the early 1950s. Even lying here in the entrance hall it has a touch of the silent film classic Metropolis about it.

Pink and yellow striped cow

In the depths of his premises he stores X-rays and maintains special archives; microscopes, emergency coffins, pictures typically hung on doctors’ walls, walking aids from every epoch. Renting them for up to ten days costs between 10 and 20 percent of the purchase price. Film-makers, photographers, set-builders, theater and museum people – they all like to stroll with Sinai through his collection, gleaning inspiration for their work from its abundance. At other times Sinai reads screenplays so he can gather together appropriate equipment.

“You need an X-ray of a broken left foot?” he asks, somewhat rhetorically, as he heads without thinking past bone saws, animal skeletons, dental impressions, and a set of scales from a pathology department towards the hanging folders where he stores stacks of classic X-ray findings. It is these which actors in white coats hold up to the light, finding perhaps a small stone which will provide the solution to a crime.

Shai Sinai has become one of the greats in a business which he did not even know of before his practical training: “A prop man, they told me, is someone who can get a pink and yellow striped cow if the director needs one,” he recalls of his professional beginnings. “And me, I knew all about cows from an early age.” Sinai takes a final sip of his cardamom coffee, and carefully closes his father’s instrument bag.

Nils Schiffhauer

A Palm d’Or for The White Ribbon, a Golden Globe nomination for Cloud Atlas, several Emmys for Grey’s Anatomy, and accolades local and national for the northern German series Heiter bis tödlich – Morden im Norden (left to right) – props from Film Ambulanz Hamburg appear everywhere.
Into the Blue

Olympus, the John Flynn Private Hospital, and Dräger have opened one of the world’s most advanced VIDEO OPERATING ROOMS in Australia.

Entering the sliding doors is rather like stepping on board a submarine: sea-blue walls; cobalt-colored light; on the floor, a steel-blue circle demarcates the surgical team’s radius of action. Anesthetist Steven Koh is busy putting a patient to sleep, while ENT physician Mark Courtney is discussing the next procedure with the nurses. Assistants are laying out instruments and positioning monitors and blue-bordered spotlights. The maritime ambiance in Endoalpha OR at the John Flynn Private Hospital on Queensland’s Gold Coast has nothing to do with the nearby Pacific Ocean. The color aids cool concentration and relaxed work. It also symbolizes a completely new type of operating room: from here, operations are recorded on camera and sent out on the Internet in real time to specialists all over the world. Discussion and questions are actively encouraged. “This operating room is one of the first of its kind and it certainly won’t be the last,” says Dr. Ray Randle, whose ideas and persistence have helped the globally networked video OR become a reality.

Looking over doctor’s shoulder

From the ceiling of the ‘blue salon’, a wide-angle camera captures the preparations. In the center of the Dräger Polaris 760, an LED luminaire, a second camera focuses on the patient’s ear which is to be operated on. This more detailed camera transmits high-definition (HD) images of every one of the surgeon’s interventions onto screens in the room. Vessels, organs, incisions, and procedures can all be seen crystal clear. And all of it can also be viewed on the hospital’s website. Students in Europe and India – as well as medical specialists in the USA – can watch the procedures live and pose questions about the surgeon’s methods and technology. What happens in the operating room is of
course not for everybody. It does allow a specialist in Germany to watch the Australian surgeon perform a complex joint reconstruction, and it does allow a Chinese student to learn more about a urological operation which is not yet well known at his university. But you may not look over the doctor’s shoulder without authorization. To protect patients’ privacy, there are complex security barriers which allow only registered users to view the online broadcasts.

Orthopedic surgeon Randle normally makes between 12 and 15 international trips each year – especially to the USA, Germany, and Asia – to share his work with colleagues and students. They are interested especially in ‘Randle’s Knee’, the Australian physician’s special prosthetic operative technique which is as difficult as it is successful in achieving swift healing results. Little wonder that others wish to learn from him. “But all the travelling I do costs time and energy – and it can also have drawbacks,” explains Randle, while behind him the OR is prepared for a new patient. For organizational reasons, he and his team are working today in the neighboring operating room. Ten new knee joints are on the agenda. An average Friday’s work.

Third camera on the forehead?

Meanwhile, in the blue operating room opposite, Dr. Courtney acquaints himself with the new technology. “It always takes a little while for a team to accustom itself to a new setting,” he says, adding in jest: “We ENT doctors could almost do with a third camera on our foreheads, since we move our heads less than orthopedists while we work, and we sometimes bend closely over our patients. Unfortunately that means we can easily block the camera’s view.”

During the next patient, two special monitors show Courtney and his opposite assistant, Stephanie Gant, exactly how the endoscopic operation on the nasal septum is proceeding. During this procedure the lights in the operating room are dimmed to blue and the screens become the surgeon’s second pair of eyes. For orthopedists and internal medicine specialists, the detailed camera integrated into the OR luminaire is especially useful. Replaceable, sterile casing protects the objective which focuses automatically onto the area of the body being treated.

“We often invite doctors for training: Australians, of course, but also colleagues from other continents,” says Randle. “Educational trips of this kind are naturally expensive, and then there are the difficulties of visas and scheduling. Our online broadcasting technology allows us to reach a lot more people,” >
Organs and vessels are shown in detail on the HD display

> he says, and explains another benefit: “Before now, a doctor might have been able to observe one or two operations during a visit. But now there is a timetable online which allows doctors to study an operation as often as they want, at times that suit them. The heightened learning experience gained by watching something repeatedly represents an enormous step forward.” It also allows difficult situations to be discussed directly if the operation is live. As well as the cameras, there are microphones connected up. “I’m used to explaining what I’m doing while I work, and why I’m doing it that way,” says Ray Randle. “It doesn’t bother me if people ask questions while I’m busy.”

When the first patient was operated on in Operating Theatre 1 (OT 1) two years ago, it was the fulfillment of five years of hopeful thinking on the part of the orthopedist. “The first crucial thing was the top-quality of the HD images. Partially focused shots would not have been any use to anybody for this purpose.” Next of all the finances had to be secured. After that there was logistical mountain to climb: hospital reality, architecture, new technology, and modern design all had to be brought into alignment. Dräger Australia had to work for two years with Olympus system integration experts and Ramsay Health, which operates the John Flynn Private Hospital, to come up with optimum solutions for the project. “The result met our expectations at first, then it exceeded them,” says John Cotroneo, who manages Dräger’s infrastructural department in Australia. He shows us a photo of the room before it was converted: a kind of storage room with neon lights and a problematic ceiling, hardly recognizable now that it has become a blue, high-tech operating room. Cotroneo is also very satisfied with the way the rest of the pilot project went: “We have since installed other Polaris systems in the John Flynn Private Hospital, equipped several new gastroenterological and endoscopic operating rooms, and furnished other operating rooms in other hospitals as well.”

Relaxed eyes see more

Four months after the first operation in John Flynn’s new operating room, the teams had accustomed themselves to the peculiarities of the blue operating room. “We had to wean ourselves from kicking open the doors,” laughs anesthetic nurse Joanne Death. For hygienic reasons, doors in hospitals are often opened using only the foot, but the modern sliding doors here are not like that. They slide silently aside at the press of a button and close automatically after a delay. But to allow the former foot method to be used if needs be, rubber pads with sensors beneath them have been attached next to the doors.

The blue color creates the ideal contrast for the cameras, and it also has a calming effect and relaxes the eyes, which is especially useful in the concentrated atmosphere of an operating room. For anesthetists, however, it means concentrating harder: veins and the skin-color of the patient are harder to make out in blue surroundings. “The monitors do of course provide us with exact details of heart rate, blood pressure, and the patient’s state. But my observations provide additional information,” says anesthetic nurse Joanne Death. “That is why we don’t always turn on the blue light,” says Ray Randle. But even when he switches to the white Polaris lights, the blue glass walls reflect a cool brilliance. The screens stand out from their dark-blue surroundings. Viewers around the world can study the OR arrangement through the wide-angle camera, whether the light is blue or white, although they are more likely to remained glued to the detailed camera, which shows the bodily parts being treat-
ed and the surgeons hands. One of the advantages of this camera is that it also helps the team in the OR. “Last week, the camera showed a lengthy aorta operation on the wall screen,” recalls Priscilla Vanwyk, who is currently making the transition from ward to OR nurse. “I was able to follow everything very exactly on the screen, see the organs and vessels as I had never seen them before, and watch carefully how and where the assisting nurses placed the clamps.” In a conventional operating room, the surgeon’s shoulders often block the view for OR nurses.

Pioneering work

That one of the world’s most advanced live operating rooms should open in Queensland’s John Flynn Private Hospital of all places is an honor indeed to that institution’s namesake. Flynn was a pioneer of innovative technology and played an important part in Australian medical care. In 1911 he opened the first Bush hospital, and 15 years later the Australian realized his visionary idea of airborne doctors who could be called into the Outback by telegraph. Flynn’s Flying Doctors (see also page 5) have to this day flown 27 million kilometers annually to treat up to 750 patients each day in far-flung regions of the continent. The Endoalpha OR has reduced doctors’ airmiles, but it still sends medical knowledge and skills out into the big wide world.

Julica Jungehülsing

Product info:
And then there was light – Dräger Polaris OR lights.
www.draeger.com/108/polaris

Almost like a television studio – but this room is primarily an operating room, equipped with high-tech medicine for the best possible treatment.

Almost shadow-free and with a bright beam – the Dräger Polaris OR light casts the patient in the right light.
“You have to be ready for anything”

Even the core region in which the nongovernmental organization AMREF FLYING DOCTORS operates from its base in Kenya is as big as the European Union. The conditions it operates under can be adventurous to say the least. If you work here you have to be committed – beyond the normal call of duty.
Passionate helper: Festus Njuguna has worked as an air rescue assistant in Kenya for the past five years. What this demands above all is experience and a talent for improvisation.

Festus Njuguna is clearly used to what he does. An air rescue assistant, he checks the charge levels on several batteries and stashes medications in a cooler-box. “I mustn’t make any mistakes,” he says. “Somebody’s life may depend on us having everything we need with us.” Njuguna works for AMREF Flying Doctors, part of the African Medical and Research Foundation. They fly physicians and assistants on rescue missions throughout Africa from the Kenyan capital of Nairobi.

The call which prompted Njuguna’s activity was received a few minutes ago at AMREF’s control room from the western Kenyan town of Kisumu. They asked whether the Flying Doctors would be able to transport a patient with cardiac arrhythmia to Nairobi, 350 kilometers distant. The 66-year-old, they said, is in the intensive care unit of a hospital. When a call like that comes in there are certain questions that have to be answered. “We try to get as many details about the patient’s state of health as we can,” says anesthetist and intensive care physician Andreas Lütgen, who is working for the Flying Doctors for a month. Alongside voluntary assistants like him there are a number of physicians working in nearby hospitals who are allocated to AMREF missions. At any given time there are more than a dozen doctors on standby to respond to multiple emergencies at the same time. Nor is there a shortage of aircraft. As well as three of the organization’s own, other ambulance jets are available to charter. Around 1,000 patients are evacuated in this way every year: foreigners who work in the region as well as tourists and the locals of East Africa. They are flown out following road accidents, if they are seriously ill, and if they need to be rescued from mountains like Kilimanjaro and Mount Kenya. Then there are humanitarian missions for locals who have no insurance. This can include women in far-flung regions who are in danger after experiencing complications in childbirth. Once or twice a month the Flying Doctors repatriate patients and fly them back to their home countries. In such cases they work in conjunction with various organizations. If a patient has to be relocated from Africa to Europe, then they meet with the ADAC halfway, in Egypt. Since the founding of AMREF Flying Doctors in 1957, more than 15,000,000 miles have been flown like that in propeller aircraft, jets, and helicopters.

Helping out in crisis areas

German medic Andreas Lütgen will fly to Kisumu this afternoon. His enquiries have so far yielded limited information. “It’s often like that,” he says. “And anyway, you can never be sure that all the information will be quite right.” Sometimes a patient’s condition worsens in the time between the call and the arrival of the rescue workers. “You have to be ready for anything,” says Lütgen. Depending on the mission, several hours can pass until helpers actually arrive at the scene. AMREF Flying Doctors also fly to crisis regions like the
Democratic Republic of the Congo. And even East Africa, the core of their area of operations, is as large as the European Union. That is why the rescue workers often have to fly for several hours – even in the fastest jets.

Tiresome formalities
Valuable time is often wasted on tiresome formalities: landing permits, overflight permits, and meeting visa conditions for patients and medical personnel in cross-border missions. Patients cannot always simply fly into Kenya, however critical their condition might be; first they require the necessary entry clearance from the Kenyan authorities. “We have blanket permission for many countries,” explains German physician Bettina Vadera, who is herself an emergency medicine specialist and who directs the AMREF Flying Doctors NGO. “But in politically unstable regions especially, the documents have to be renegotiated and re-issued every single time.” It helps for the physicians to have a long list of telephone numbers for each country they work in, so that they can contact people who are able to influence the responsible authorities. But there can be problems, depending on the time of the day. “Sometimes we’re told that the person responsible is not available on the phone at the moment, for a variety of reasons.” This can delay a flight considerably. For seriously injured patients, this in turn can mean dramatic minutes or hours suspended between life and death.

Getting to the place as quickly as possible is one of the biggest challenges.
“Sometimes we are happy if we arrive on the same day at all,” says Vadera. Conditions when they get there can be adventurous to say the least. Pilots often have to make do with bush airstrips whose state changes frequently depending on the weather and the time of year. Heavy rain and wind can sometimes cause floods and potholes. And some patients still have to be collected from the middle of nowhere once the plane has landed. If there is no off-road vehicle available, a mission can quickly fall flat. “There is an extraordinary amount of organization behind getting to our patients,” says Vadera.

“Who’s paying the bill?”

Festus Njuguna has now packed everything for the flight to Kisumu. It is just before three o’clock. A single-engined Cessna is standing ready. The flight to Kisumu takes an hour. “Africa from the air is always spectacular,” says Lütgen, looking often from the window on the flight out. Below him stretches the East-African Rift, which was created by the separation of the Arabian from the African Plate around 35 million years ago. When pilot Emmanuel Wanyela lands the Cessna, a vehicle is already waiting for them. Everyone lends a hand to get the medical equipment as quickly as possible into the automobile – including pilot Wanyela: “We’re a team after all.” As his colleagues leave he entreats them: “Please hurry up, a storm is brewing – we should take off again as soon as we can!” Njuguna and Lütgen do not disclose the time-pressure they are under when they meet the patient at the intensive care unit. The patient seems strained. He has two questions: “How am I getting to Nairobi?” – “By plane,” answers Njuguna. “And who’s paying the hospital bill?” – “It’s already taken care of.” He has a right to be anxious. Many hospitals, not wanting to be saddled with the costs, do not allow their patients to leave until they have settled the bill. The patient is then handed over into their care. He has had two cardiac arrests in recent days, explains the physician on duty. The helpers from Nairobi clarify some other details before sticking electrodes to his chest, supplying him with oxygen, and connecting him up to a transport monitor. This allows blood pressure, oxygen saturation, and heart-rate to be monitored during the flight. “If he has another ventricular fibrillation we can defibrillate him immediately,” explains Lütgen.

They then set off through the rush-hour traffic back to the airport. The wind foreshadowing the rain has picked up considerably. A broad cloud of dust is approaching. As the first drops begin to fall, pilot Wanyela asks them to hurry. The patient is becoming restless and complaining of a shortage of air. He is breathing himself, but is given more oxygen. A quarter of an hour later the heavy clouds are behind the Cessna, and as dusk draws near the plane lands in Kenya. The patient is taken to Nairobi Hospital accompanied by Lütgen and Njuguna. Their work is done for the day. What awaits them tomorrow, they do not know.
Steel Hamster’s Wheel

Rescuing people, extinguishing fire, saving lives: when the going gets tough, firefighters need a safe supply of breathing air. A production facility in the north of England makes sure they get it. This is where heavy-duty BREATHING APPARATUS is developed and made for the whole world – from individual parts to finished products.
A silky purr, then a gentle clic: cold steel meets gleaming bronze. With this overture in fine-mechanical pianissimo, a robot’s arm steers a pellet into the chamber of a milling machine. The doors close and a humming sound issues from the big box. Coolant and lubricant runs in fine tears down the inside of the plastic viewing window. While the machine forms the blank with precision holes and threads, the next parts wait on plastic trays with suitable indent. They are lined up like the golden, shimmering figures of a strategic game in which every move takes you closer to the finished component: a pressure reducer for breathing apparatus. Automatic processing of these blanks is one of many working stages done by Dräger, in Blyth, to complete a component of heavy-duty breathing equipment such as compressed air breathing apparatus. Production involves both: delicate manual work and modern robotics; in one place a system winds carbon fibre around compressed air cylinders at a dizzy speed, while else where needles embroider the Dräger logo in white thread automatically into straps. Alongside sit experienced technicians who are assembling the mechanical control components of the pressure reducer.

“We develop, manufacture, assemble, and test our products ourselves,” explains Dave Hodson, who is responsible for sales of the breathing apparatus. This fact is acknowledged not only by customers, but also by Britain’s mechanical engineering industry as a whole. Two years ago the plant, which is situated 25 kilometers north of Newcastle upon Tyne, received the MX-Award for manufacturing excellence from the UK Institute of Mechanical Engineers.

Hotbed of industrialization

The men and women who work there, with their typical friendly north of England accents, are proud of what they make for firefighters around the world and they supply a sizeable chunk of the world market. “We can make several hundred pressure reducers and lung demand valves in one day,” says Martin Winter, Production Technologist at Blyth. The number of employees has more than tripled since they began production there. The roots of this British location lie in a joint venture between Westland Helicopters and Dräger, which was founded in 1963 with the name Dräger Normalair. In 1974 Dräger bought out the Westland shares, creating Dräger UK. The area where the estuaries of the Tyne and Blyth rivers run into the North Sea has always been a hotbed of industrialization. It was here that the railway was invented and gigantic shipyards rose up. Coal was mined here and exported. Bridges were built which still shape the landscape today. The glorious age of heavy industry may be long gone, but if you visit the development department at Dräger in Blyth, you can still sense the inventiveness and the spirit of engineering.

This is where all the elements of breathing apparatus are developed and undergo harsh functional tests. In practice they have to stand up to flames, smoke, and heat, as well as moisture and icy cold. That is why the test center houses a range of equipment and apparatus for mechanical user testing, including a large steel rotating hamster’s wheel which simulates hours of heavy impacts of use by the firefighters. Selected compressed air cylinders are tested by pumping them up to over 1,000 bar until they burst. In another test, the charging and discharging of cylinders is simulated to ensure they do not fail under use by the customer.

“Our production tests are part of an overall process which ensures close collaboration with design, development, and quality assurance,” explains Martin Winter. “This enables us to not only achieve a high product quality, but also to integrate items of production equipment in the best possible way into the system as a whole.” These are things that Winter values highly – especially if he looks to the future of breathing protection. “Mechanics and electronics will merge closer and closer together. This includes a stronger integration of telemetry and communication into the equipment, but also improved matching between protective clothing and breathing apparatus.”

At the heart of the breathing equipment is a mechanical controller that supplies a steady flow of breathing air to the user, an arrangement they do not wish to abandon. The breathing air is stored in the cylinder at 300 bar and once connected to the breathing apparatus it is passed through a pressure reducer to reduce the air to 6–9 bar.
Reliability in detail: components of Dräger breathing apparatus are manufactured and assembled in Northern England – from pressure gauges (left), to pressure reducers (center), to harnesses.

Customer feedback is important for the development of new products

> (otherwise known as medium pressure). This flow of air is then controlled by the lung demand valve to give users the correct amount of air they need. “Three hundred bar may sound modest at first,” says Dave Hodson, “but it’s almost a hundred times more than the pressure in an automobile tyre.” It enables around 1,800 liters’ of air at atmospheric pressure to be stored in a cylinder with 6 liters of volume.

Firefighters and other rescue workers depend on a reliable supply of air from this source during their missions. Dräger, therefore, represents not only breathing apparatus, but also the trust customers have in the equipment they use. This in turn is based on mutual collaboration, since engineers at the design and development department value the experience users gain on their missions. “Feedback is important for the development of new products and to continuously improve the existing portfolio,” says Martin Winter. One of the themes that are important to users is close collaboration with the customer to innovate and develop an ergonomic carrying system. By design engineers analysing the movement of firefighters and determining pressure points during use, they can tell...
which parts of the carrying system need to be improved to ensure a better distribution of weight for the user. In heavy-duty breathing apparatus it all begins with the air in the cylinder. Today’s standard cylinders are made of aluminum, carbon fiber, and glass fiber instead of heavy steel. When they are made, each cylinder is wound using strands of carbon fiber, each strand being several hundred meters long. The carbon criss-crosses the cylinders like the thick, shining strokes of a soft crayon. Once this carbon armor has covered the cylinder six times a glass fiber layer is applied. This cocoon is cured, ground smooth, and resin – coated before being painted. The Dräger Tartan Cylinder, popular in Europe (excluding Germany), is an unpainted cylinder which shows off the pattern of the carbon. This name is an affectionate nod to Dräger Blyth’s Scottish neighbors.

Passing through the pressure reducer, the air goes into the lung demand valve which is controlled by a spring. If the medium pressure in the lung demand valve drops below a preset level, the spring’s force and atmospheric pressure combine to overcome the valve in the high-pressure area, and air flows through the valve towards the mask and the user. The body of the pressure reducer is machined from a special alloy. Prototypes of any newly developed versions are made from solid blocks of material in the company’s own model workshop on a CNC milling machine, but in actual production, pre-shaped blanks offer considerable advantages.

Their exterior dimensions are very similar to those of the finished component, meaning that only a small amount of material has to be taken off.

The right equipment
Manufacturing in Blyth focuses on all of the components of the PSS 3000, 5000, and 7000 breathing apparatus, as well as the PAS series. “This means we have the right equipment for any firefighter, whether voluntary or full-time – all of whom are professionals,” says Martin Winter. The PSS 5000 and 7000 offer a particularly high level of individuality. This includes telemetry systems which can transmit essential data from the seat of the fire to a control center, making things even safer for the firefighters.

“When we develop new components we always look at the system as a whole, from the lung demand valve, to the pressure reducer, to the cylinder – and of course all the other parts of the equipment,” says Dave Hodson. That is why the breathing apparatus experts in Blyth believe that a close alliance between research & development and production is so important. This is reflected not only by the internal structure at Blyth, but also by a customer-focused approach and full system integration. “That alone is almost a unique selling point to our customers,” says Martin Winter. Peter Thomas

Video: Flying visit – visiting the breathing apparatus plant in Blyth.

www.draeger.com/108/pss
Better Safe than Sorry

The Quaestor 7000 tests – automatically and in compliance with a range of national regulations – whether breathing apparatus, scuba equipment, masks and chemical protection suits work and do not leak. This device simulates human breathing, and software performs the measurements and documents results. High-pressure inlet [1] is fixed firmly to a pipe under a pressure of 300 bar. An electronic valve controls the pressure together with nine others, which enable the software to perform program-controlled testing of systems such as compressed-air breathing apparatus. It is connected to high-pressure outlet [2], the pressure is reduced to 7.5 bar, and led to a retractable medium-pressure inlet [3]. A sensor measures the pressure and supplies it to the rotatable medium-pressure outlet [4] which is connected to a diving regulator. This in turn is connected to a full-face breathing mask which can be attached to the test head [5]. The opening [6] represents the mouth, through which breathing is simulated. A replaceable gel face [7] is similar to human skin and the tissue beneath it, so that the way the mask fits can be simulated in as realistic a way as possible. The measuring point [8] measures the pressure inside the mask while pressure devices are being tested.

The warning signal on the breathing apparatus is also tested automatically. It is measured by a microphone [9], and should always sound whenever a particular pressure limit is exceeded.

The testing and documenting of a compressed-air breathing apparatus takes around five minutes.