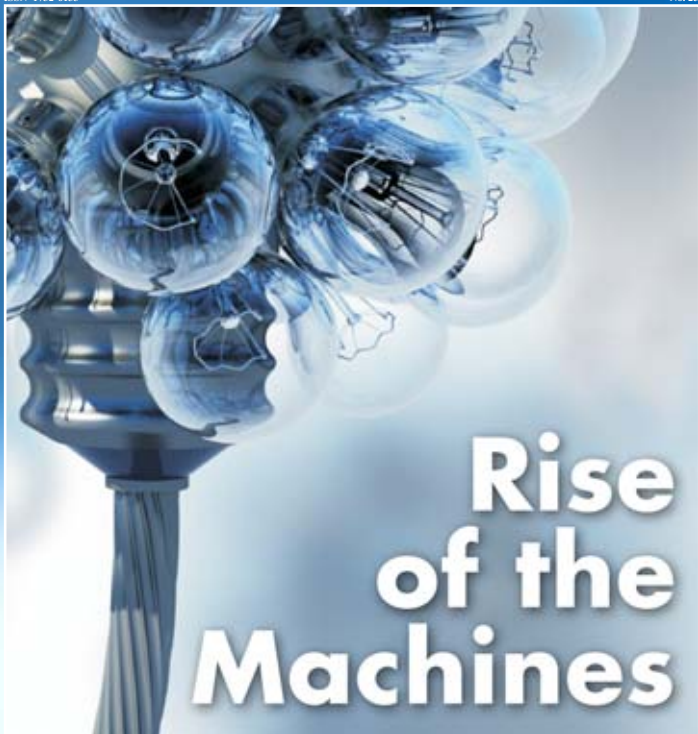


THE POLISH SCIENCE

VOICE

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**Rise
of the
Machines**

From the Publisher

A few years ago, I asked the Polish prime minister at the time if his tight schedule allowed him to take his eyes off his day-to-day business and look into the future on occasion. The politician said no.

Michał Boni, head of Prime Minister Donald Tusk's team of strategic advisers, does more than just keep his mind on the government's immediate concerns. He looks further than that. Boni, who used to work as a sociologist at the University of Warsaw and was a prominent member of the democratic opposition under communism, is a talented negotiator familiar with all manner of social problems. His job is to handle negotiations with labor unions and diffuse tension whenever there is a standoff between the government and a social or professional group demanding privileges. His responsibilities include preparing long-term strategies and emergency action plans for the government.

The Poland 2030: Development Challenges report compiled by Boni and his team is an action plan that aims to prevent the country from succumbing to "developmental drift." The report identifies the 10 greatest challenges that Poland is expected to face in the next two decades. These challenges are associated with issues such as competitiveness, demographic developments, economic activity rates, infrastructure, energy and climate security, the development of a knowledge-based economy,

development of intellectual capital, solidarity and regional cohesion, public administration and social capital.

Not surprisingly, science is seen as the most important tool that should be used to make sure the country avoids "drifting," according to Boni and his people.

The report says that one of the top priorities is to increase spending on research and development and encourage the private sector to finance science in the same way as in developed economies.

The Polish Science Voice regularly documents the steps that Polish scientists and technology experts, institutions and companies take on the road to a better quality of life. The marriage of science and business and a knowledge-based economy—these are not just slogans but concrete facts. In this issue of *The Polish Science Voice*, we take our readers on a tour of the Innovations-Technologies-Machines Poland 2009 trade fair that was held in the western city of Poznań in June. The exhibition featured innovative products such as flying robots controlled by head movements, infrared terminals that identify people from the pattern of their veins, intelligent pens designed to combat dyslexia, systems for controlling computers with one's eyes and lips, and ultra-sensitive cameras for astronomers.

This annual exhibition, which regularly draws crowds of scientists, technology

experts and business people, marks a milestone—and a bold step—on the road to the ambitious targets of 2030 and beyond.

One of the most prominent figures at this year's exhibition was Krzysztof Pietrusewicz, a researcher from the Electrical Engineering Department of the Control Engineering Institute at the West Pomeranian University of Technology in the northwestern city of Szczecin. He won a gold medal for his "open modular control system for numerically controlled machine tools." Pietrusewicz is a special guest of this issue of *The Polish Science Voice*.

We also report on a range of other innovative devices designed in Poland. These include a hi-tech camera intended for use in astronomy—for surveying large sections of the sky. The camera was developed and manufactured in Poland and has turned out to be the most sensitive camera of its kind in the world. We also focus on researchers' efforts to help children with heart disorders.

In another regular report on Polish universities, we describe the state-run University of Science and Technology (AGH) in Cracow, one of Poland's best technical schools of higher education, with 33,000 students in 15 departments and more than 2,000 teachers. The university is marking its 90 years this fall.

Andrzej Jonas

The Polish Science Voice

No. 25

Special Guest: Krzysztof Pietrusewicz, PhD Eng., from the Electrical Engineering Department of the Control Engineering Institute at the West Pomeranian University of Technology

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Blazing the Trail



Krzysztof Pietruszewicz, PhD Eng., from the Electrical Engineering Department of the Control Engineering Institute at the West Pomeranian University of Technology in the northwestern city of Szczecin, talks to Piotr Bartosz.

You won a gold medal at the Innovations-Technologies-Machines Poland 2009 trade fair. Could you explain the name of the prize-winning device: “control system for CNC machine tools?”

Put simply, numerically controlled machine tools are machines that make parts for other machines. They operate in many industrial sectors and without them it would be impossible to make parts for cars, components for machines, or components for robots. We decided to make these machine tools work better; to make them more accurate, faster, more precise, less energy-consuming. This research goal yielded several patent applications, a prototype system for controlling an intelligent machine tool, and finally the OCEAN (Open modular Control system for linEAR motion driver) implementation. It's one of those projects that has only advantages. It allows scientists to develop their careers for decent remuneration while offering the economy answers that the world has not yet heard of.

The intelligence of these machines means that the machine tool diagnoses its own dynamic status and launches appropriate corrective procedures to work more efficiently and accurately—such adjustments are necessary because the machine works on different tasks and in different environments. The machine tool can also eliminate unfavorable processes.

Of course we are very pleased with the gold medal. It's a reward for the research work of the team headed by Stefan Domek (PhD hab. Eng.). I am part of the team, next to Prof. Mirosław Pajor, Paweł Dworak (PhD Eng.), Łukasz Urbański (MSc Eng.), Tomasz Okólik (MSc Eng.), Marcin Hoffman (MSc Eng.) as well as Marcin Choćko (PhD Eng.) and Arkadiusz Parus (PhD Eng.) who are responsible for the measuring part of the machines and for checking whether the engineers' suggestions

cause changes for the better or for the worse. We are working on a control system for machine tools that is open in terms of both hardware and software, so that machines from different manufacturers and different software packages can be joined together.

The OCEAN system is a project leading to work on the prototype of an intelligent machine tool in which all the control system parameters could be controlled, so as to incorporate successive advanced components into the machine.

The system has been singled out for praise because of its innovative design. Is it worth developing original projects instead of taking advantage of the best models from other technologically advanced countries?

There wasn't anything to copy. The global market does have a few really technologically advanced control systems, but our solutions are of the kind that won't appear in typical projects until a few years from now. The results of our work are the property of the West Pomeranian University of Technology (ZUT)—the former Szczecin University of Technology merged with the Agricultural University of Szczecin. Companies in Poland, Germany, and the United States started working just a year ago on control system components that we had been working on for almost three years. We hope that in the future our research will define the directions of global development and that thanks to projects like OCEAN we will determine market needs, show the possibilities, and blaze the trail for new research important to the machine market.

Aren't you afraid that you won't find buyers entering the market with a ready-made design? Some say the best way to commercial success is solving specific problems reported by companies and industry. Aren't you doing things the other way round?

Running a research and development project financed from funds provided by the Ministry of Science and Higher Education means that it's we who really decide about the innovation involved. Industry workers aren't restricted by closed budgets, only by their imagination. Nobody tells us: do it now, today, on time. The extent to which we have to adapt our activity to the

project financing schedule is limited. This means that many innovative technologies are born in the course of fulfilling research tasks.

In the OCEAN project's case, this involved an innovative method of linear motor installation, which compensates for loads occurring on the machine tool's guide carriages. The project ends in April 2010, but additional projects have grown from it—both research and applications.

One of them is aimed at developing a servo drive technology for electric motor control for this system (a three-year research project has just begun); another is related to studying the impact of temperature changes in a machine controlled by the system and the problem of vibroacoustics in the machine. All these projects involve the application of research results in industry.

How can you be so sure?

As the dean's representative for contacts with industry, I have already held talks with companies that are interested, from Poland, Germany and the United States. They are encouraged by the fact that this technology is not expensive to implement. They also understand that it is a combination of technologies already present on the market but in a configuration that no one has applied in the machine tool industry before we used it in our project.

The OCEAN open modular control system for CNC machine tools is a prototype device. Who owns it?

The intellectual property rights to the project belong to the university, while in a broader sense the research results are the property of society. The project promises further development and is the basis for three patent applications. According to the rules that apply to patent applications, we are not allowed to publish the technological details. Thanks to this it will be possible in the future to carry out special projects to implement the prototypes at manufacturing plants.

What's it like when you can't boast about your research results in publications and you're not even the owner of your own invention? Is it worth the effort?

My perverse answer: Nothing could be more worthwhile. We can boast about the results; it's how we achieved them that's secret. We receive extra remuneration for our work, on top of our university salary. This is steady money and the terms seem to be much better than they are in business relations. We're doing something useful that develops us scientifically. The experience we gain during work on this project is unique, and something we can use in our future activities.

You break all stereotypes. Is it really possible to make more money at a Polish university than in the private sector?

Working on large research projects, you can satisfy your financial requirements. If a team is working on technologically advanced projects, the researchers can earn more than they would at a private company. That's why I encourage young scientists to stay at the university and establish cooperation with industry from here. This will be the nest of their development, and not companies that will mold them according to set patterns.

Why do they need encouragement? As a teacher, you observe what happens to students. The most talented graduates seem to choose laboratories less often than jobs at large corporations.

It's not true that the most talented of them work for large corporations, but it's true that we see companies fishing avidly for the university's best people. Unpleasantly surprised by the initial salary level at university, young people decide to go to industry. However, advancement at university and becoming a member of research teams leads to a substantial disproportion of earnings to the advantage of research institutions.

You are a university teacher, a researcher taking part in a huge project, and the Electrical Engineering Department's dean representative for cooperation with industry. How do you reconcile so many duties?

These activities are intertwined. University workers can have incomplete knowledge as to the new technologies that industry needs. That's why it's worth having selected researchers deal with contacts with industry. Their knowledge, experi-

ence, contacts and efforts benefit the whole team. I undertook exactly such a task. This supplements not only my research work but also my teaching. During classes I try to teach my students how to implement and also protect their research results. The university where I work doesn't yet organize specialist courses on intellectual property protection, protection of knowledge and its application, but it's possible that such



courses will appear in the future because thanks to such knowledge engineers will not be in danger of unfair conduct from companies.

Do companies treat scientists unfairly?

It happens. Recently one company came to us with a proposal to develop control system software for construction. The project included the renovation of a machine. Our researchers spent several weeks on

the work, after which the partner said we were a public-utility unit so he had no intention of paying for our software. I told the company's representative that if he brought his son to us and he passed the entrance exam, he could then expect to receive free educational assistance, and we would make sure it was of the highest quality; he would be able to take advantage completely free of charge of our work involving his son's educational development and scientific potential. However, there is no such thing as free services from universities for industry.

Perhaps he did have a point there. After all, boosting innovation in the economy should be our common goal. Don't you agree?

Yes, but the way towards it should lead through the principles that are binding in the civilized world. Today, having learned from our mistake, before we start working on a problem we calculate the cost according to the university's rates. We understand that these rates could be excessive for some companies. In such cases, with the help of regional technology transfer centers, international program offices and framework program contact points, we look for sources of funding. The company only covers the actual costs of the implementation itself, while the research is paid for from project budgets, regional and national.

Does collaboration between the university and industry bring tangible benefits?

Employees at the ZUT Control Engineering Institute have a broad collaboration with industry with regard to equipping laboratories, joint teaching, lectures by company employees, joint seminars, practical training, traineeships, graduation projects, and consulted research projects. Thanks to these contacts, companies offer the university supplementary equipment or software. This cooperation is of measurable importance also for the other side: employers want engineers joining the market after graduation to be familiar with the best, most advanced equipment currently used in industry. Such investments allow them to save on training later, because prospective employees come fully prepared for the job and not just filled with theoretical knowledge. It

would be highly irresponsible of us not to take advantage of such an opportunity, especially when we are offered significant discounts or are given equipment for free.

How do entrepreneurs know who to go to?

We are not only open to cooperation but also promote our services. The university has published a brochure with technological proposals from individual units from all the departments, to give to prospective partners. The brochure lists the names of contact persons and the technologies in which each team specializes. We also have specialists who can help scientists put a price on their skills. An original idea emerged at the Electrical Engineering Department to expand the information base by having the website include an electronic database of the skills of individual students, of course if they are interested.

Do students want to combine learning with work to gain professional experience?

Increasingly often. This isn't about drawing them away from studying. Collaboration with the private sector isn't the only form of maintaining contacts with business. We are also taking part in a project involving orders being placed for university courses. Support under the Human Capital Operational Program is available for automatic control engineering and robotics as well as electrical engineering. We have obtained funding for the project for 2009-2013, when scholarships of z.l.1,000 per month will be granted to 45 students of the bachelor's level course in automatic control engineering and robotics, and 15 master's level students. Apart from these 60 students, scholarships will be offered to 150 students of mechatronics, materials engineering as well as mechanical engineering and machine building at the bachelor's and master's level at the ZUT Mechanical Engineering and Mechatronics Department. This is substantial assistance for these young people, who can focus on studying without having to look for extra income. This large project will allow us to offer many more attractive classes in the four courses in question, resulting in the market receiving new generations of—I am firmly convinced—some of the best-educated graduates in the country, well prepared for coping on the labor market.



INNOVATION ON DISPLAY



A flying robot controlled by head movements that makes Full-HD movies, an infrared terminal that identifies people from the pattern of their veins, an intelligent pen to combat dyslexia, systems for controlling computers with the eyes and lips, a device for keeping the water in your swimming pool clean, bulletproof vests, ultra-sensitive cameras for astronomy—all these innovative products and technologies were on display at the Science for the Economy Show in Poznań in June. The show was part of the Innovations, Technologies, Machines Poland 2009 trade fair.

The fair attracted more than 1,000 exhibitors and 20,000 visitors. The Science for the Economy Show featured the achievements and research potential of Polish applied sciences. The show, held regularly as part of the ITM fair, aims to bring science closer to industry and facilitate business contacts, fostering the transfer of research results to business.

Innovative technologies that modernize production processes and reduce costs are the best investment at a time of crisis, experts say. This year, 20 exhibitors, mainly research and development centers, schools of higher education and institutions that support innovation, showcased more than 60 technological innovations.

The West Pomeranian University of Technology from Szczecin showed its innovative OCEAN control system for CNC machine tools. The robotics and mechatronics faculty of the AGH University of Science and Technology in Cracow, together with the Unihut company, showcased designs such as unmanned aircraft that can lift off and land by themselves and fly along a pre-defined route based on their onboard GPS navigation system. The aircraft are equipped with a video platform that was unveiled at the same time. The camera can be controlled manually or automatically through the head movements of a person wearing virtual glasses.

Mobile robots designed by the AGH University of Science and Technology can autonomously transport components in a production hall, mapping their own routes and communicating with one another during operation. They can be used for the unmanned transport of parts or for drawing a map and gathering information about an area that is in some way hazardous to humans. "Their future also includes working in outer space," says the university's Dr. Tomasz Buratowski.

The robotics and mechatronics faculty's stand at the fair also featured a parallel robot that consists of two parts. The macro-robot positions the camera and the microrobot. The microrobot's

movement range is just a few millimeters, but the manipulators' motion precision is high. They can be used to perform operations on cells, such as piercing the cell wall and inserting material into the cell, for example. The AGH University of Science and Technology won a gold medal for its cell-operation robot.

Show us your veins

The Institute of Mathematical Machines exhibited its IMMVein terminal for infrared identification of people by the pattern of the veins on their hands, which is unique for each individual. Unlike fingerprints, vein patterns are difficult to forge because they do not leave their trace anywhere. The pattern does not change as the person grows. The left hand is different from the right, and even identical twins have different vein patterns even though they can have identical fingerprints. A few percent of the population cannot be registered with popular fingerprint-based systems because they have damaged fingers, psoriasis, or their skin is in poor condition.

Computer controlled by the lips

Scientists from the Gdańsk University of Technology's Department of Electronics, Telecommunications and Informatics showcased an "intelligent pen" for dyslexics and a computer controlled by eye and lip movements.

The "eye-tracker" uses torches emitting infrared light and an internet camera. The system tracks the reflections of the light in the pupils. Based on geometric calculations, the device identifies where the person is looking. The algorithms work for both bright and dark pupil tracking.

The applications for this invention are not limited to helping disabled people. It can also be used in marketing research, at schools and by psychological counseling services where it is



The Lip Mouse device uses a typical internet camera to analyze images of the user's head

important to be able to tell if children do not do well due to some problem or defect, or because they are not concentrated during a test and are looking somewhere else. The system will be five times cheaper than those available on the market today, the designers say.

The Gdańsk University of Technology's Faculty of Electronics, Telecommunications and Informatics has developed telemedicine, a branch of technology that employs the internet to diagnose hearing, visual and speech impairments. The faculty has also designed an artificial larynx for patients who have had their larynx removed. A digital signal processor used in the artificial larynx radically improves the quality of sound produced by the device.

One of the faculty's most remarkable inventions is the Ustomysz (Lip Mouse) Computer Multimedia Interface, a system designed for those who, due to paralysis and other disorders, are unable to use the computer in the traditional way. The interface enables such users to control a computer with head movements and facial expressions. It is the only such device in the world.

The Lip Mouse device uses a typical internet camera to analyze images of the user's head. When a person opens their mouth, sticks out their tongue or purses their lips, this can be configured with any function of a computer mouse in accordance with the user's preferences. The scientists from the Gdańsk University of Technology have supplemented this invention with an application—a communicator allowing a paralyzed person to request food, drink or help. A speech synthesizer is part of the system.

Tachographs with a difference

The Industrial Research Institute for Automation and Measurements (PIAP) showed tachographs, or systems that record the parameters of aircraft and trains. The PIAP's tachographs have won a special mention in the Teraz Polska (Poland Now) competition. An electronic tachograph records all data related to a vehicle's journey: distance, speed, time and all the activities undertaken by the driver. The data are stored in an electronic memory chip that can be read on a PC after the journey. The designers have developed special PC software for dis-

playing, presenting and archiving data. Buyers of the tachograph received the software as part of the package.

The Polish tachograph is competitive in terms of price compared with similar projects developed in other countries. It can be up to 30 percent cheaper than its Western counterparts while meeting all the requirements set down by European law.

Other wonders

The University of Warsaw, together with the Creotech company, unveiled a system for the sanitary control of swimming pools. The system monitors physicochemical parameters important in pool maintenance.

The Institute of Electronic Materials Technology (ITME) from Warsaw displayed its cutting-edge laser technology that has been applied in business. Modern technology allows scientists to build heavy-duty lasers that are more energy-efficient than traditional lasers. Their miniaturization is also more advanced, enabling them to be used in robots, for example as operating heads. "A laser beam can weld together various materials, bond plastics, cut and form different shapes and even engrave portraits," says the ITME's Tadeusz Zero.

Experts from the Institute of Nuclear Chemistry and Technology in Warsaw exhibited a system designed to treat waste gases from power plants with an accelerated electron beam and produce fertilizers at the same time. The technology has been used on an industrial scale for the past seven years at the Pomorzany power and heat generation plant in Szczecin. This industrial research project was built under a contract between the International Atomic Energy Agency in Vienna and the Japanese and Polish governments.

In another project, the institute's station in Warsaw sterilizes foodstuffs and medicines using safe radiation. Food subjected to this process retains its nutritional value, and the technology is safe, non-toxic and bactericidal, experts say.

The Institute of Mechanized Construction and Rock Mining showcased an ultra-fast innovative two-die riveting head. The Moratex Institute of Security Technology exhibited its advanced bulletproof vest for police officers, and the Metal Forming Institute exhibited a machine for making road signs.

Innovative products were also on display at the stand of the Institute for Sustainable Technologies/National Research Institute, the Komag Institute of Mining Technology, the Tele and Radio Research Institute, the Technical University of Łódź, the Poznań University of Technology, and the Construction Equipment Research Institute.

The list of winners of Poznań International Fair Gold Medals for the transfer of research results to business also included the Institute of Precision Mechanics for its technology of precision gas nitriding; the Metal Forming Institute for its technology for forming rings for elastic shock absorbers; the Institute of Non-Ferrous Metals for its method to produce high-quality lead-acid batteries and new ecological copper alloys; the Industrial Institute of Agricultural Engineering and the Institute of Chemical Technology and Engineering of the Poznań University of Technology for their technology for obtaining engine fuel from vegetable oils.

Piotr Bartosz

“An increase in spending on education and science to 4 percent of the GDP might sound like utopia today, but I fear that by 2030 even that level may be insufficient for Poland to be in the lead internationally.”



Poland 2030

A government think tank has compiled a report to initiate public debate on what needs to be done to improve the quality of life in Poland in the next 20 years.

According to the report, entitled *Poland 2030: Development Challenges*, the country's gross domestic product should grow at an annual rate of 5 percent and investment is expected to grow by 25 percent each year. Hi-tech products are expected to account for 40 percent of the country's exports, and 75 percent of the population, including 35 percent of the disabled, should have jobs.

The report was written by Prime Minister Donald Tusk's team of strategic advisers headed by Michał Boni (pictured). It aims to “provide food for thought and inspire debate on how to

improve the quality of people's life, irrespective of how old they are, where they have been born, and where they live,” said Tusk at the report's launch at the Warsaw University Library in June.

Measures needed to improve the quality of life in Poland must be taken despite the fact that the country is dealing with the effects of the international economic crisis, Tusk said.

In the report, the prime minister's advisers identified the 10 greatest challenges Poland is expected to face in the next two decades. These challenges are associated with issues such as competitiveness, demographic developments,

economic activity rates, infrastructure, energy and climate security, the development of a knowledge-based economy, development of intellectual capital, solidarity and regional cohesion, and public administration.

A new lodestar

According to government experts, the report is a new lodestar for the country. “We need it because the two periods of development which have driven the country so far—the transition after 1989 and entry to the European Union in 2004—will no longer be sufficient for Poland to be able to compete successfully with other countries in the global marketplace,” said Boni. If Poland is to avoid what the experts call “developmental drift” it should identify its weaknesses, goals and ways of achieving them, Boni said. “This should be done now because the future starts today,” he added.

According to Boni, Poland also needs a long-term strategy because the crisis may offer an opportunity to modernize the country. Poles only need to muster the courage to carry out reforms, Boni said.

The report proposes a model of development based on “polarization and diffusion.” This means supporting the key “poles of growth” whereby large Polish cities would be able to compete successfully with other cities in Europe, and decision makers would strive to remove obstacles to the development of other areas. This “diffusion” is supposed to help equalize educational opportunities, build inter-generational solidarity, and give people a feeling that they can fulfill their aspirations, according to the government.

The authors of the report believe that, in order to ensure stable economic growth, Poland should shift tax burdens from direct to indirect taxes, manage public finances through “task-based” budgets, enter the euro zone, and offer preferential tax treatment to investing companies. Thanks to these measures, the country's long-term economic growth in 2009-2030 is expected to accelerate to at least 5 percent per annum, with annual inflation remaining within the 1-3 percent band. The proportion of exports based on modern technology is expected to increase to 40 percent from 3.1 percent today; the contribution of high-tech sectors to GDP

generation would rise to 25 percent, and the long-term investment rate would go up from 18 to 25 percent.

The report assumes that there will be a rise in employment and fertility rates so that the ratio of the economically inactive to economically active population is reduced to 1.1-1.2 by 2030, from 1.7 at present. By 2030, the retirement age of men and women would be equalized and extended to at least 67 years.

Efficient public administration is an important part of the strategy, Boni said. Apart from reorganizing and modernizing public administration, the court system and the law-making process, the project involves the development of e-government. The report calls for the development of flexible forms of employment, which will make it possible to combine work with education and family life. Modern forms of assistance would be offered to the unemployed. As a result, the average unemployment rate would stay below 5 percent.

The report calls for developing transport infrastructure, with an increase in the average speed of trains and the density of freeways and expressways. Much hope is being pinned on computerization. In 20 years, 75 percent of Poland's households are expected to have high-speed internet access. At present, 48 percent of households have internet access and 38 percent have broadband access.

Under the strategy, spending on research and development would rise to 4 percent of GDP annually, with at least 2 percent coming from private sources. The proportion of scientists working in the private sector would increase from 8 to 40 percent, and the proportion of students in engineering, technical, mathematics and computing faculties would rise to 20-25 percent.

The report does not propose any specific measures to be taken. Its main aim is to initiate public debate, officials say. The government wants to prepare a package of detailed proposals by the end of next year.

Intellectual capital

"An increase in spending on education and science to 4 percent of the GDP

might sound like utopia today, but I fear that by 2030 even that level may be insufficient for Poland to be in the lead internationally," said Boni.

According to Boni, Poland needs a system of education that could provide everyone with equal access to knowledge and at the same time make sure that "talented individuals can be spotted and get their chance." An education boom alone cannot radically improve the quality of human resources, Boni says. In 20 years, a university education will be hardly a pass to a career and graduates will have to constantly broaden their knowledge; creativity and new



The report's launch at the Warsaw University Library in June

ideas will be essential, Boni says.

Without structural changes in the system of innovation and education, Poland's intellectual capital will fail to develop fast enough to meet the needs of the economy, Boni says.

Under the strategy, the number of scientists working in the private sector should rise from 8 to 40 percent, while the number of students majoring in engineering, technology, mathematics and computer science is expected to rise to 25 percent.

Making dreams come true

"Making forecasts for the next 20 years is of key importance to the country's development," says Prof. Jerzy Buzek, an ex-prime minister of Poland who was recently elected president of the European Parliament. "In this way we know what kind of strategy we want to pursue, what goals we want to achieve and what dreams need

to be fulfilled. In the 1970s, we dreamed of a free Poland, but we never thought it would happen in less than 20 years. It did. Today, our dream is for the forecasts and predictions contained in the report to materialize—at least in part."

As far as the state of the economy is concerned, experts say Poland is doing the best of all EU member states. Still, the country lags behind most other EU members in innovation. Spending funds on research and new technology is a priority these days, Buzek says.

According to Prof. Ryszard Pregiel, an expert with the Polish Chamber of

Commerce for High Technology, stronger bonds between business and science are of fundamental importance in Poland. It is vital to upgrade the system under which science is managed and financed in this country, Pregiel said. He called for a thorough reform of Poland's science sector, which needs to be financed by the private sector, he said.

Poland's exports are expected to be 40 percent made up of modern products and services 20 years from now, up from 3.11 percent today. According to Pregiel, this is a bold target because "the world does not stand still." He called this challenge "a new patriotic goal," adding that the report emphasizes the need to build a knowledge-based economy in Poland.

One of the top priorities defined in the report is to increase spending on research and development and encourage the private sector to finance science in the same way as this is done in developed economies. According to the report, the private sector can become involved in funding innovation if the science sector embarks on applied research and development projects, which should account for 75 percent of all funds spent on research. "Institutions of higher education account for a lion's share of researchers and unless they make the effort to reform their policies and learn to sell the findings of their research, the private sector's involvement in research and development will remain low," the report says. "Injecting even

REPORT HIGHLIGHTS

Key targets for Poland by 2030:

- average annual growth of 5 percent in 2009-2030
- 40 percent proportion of hi-tech products in exports
- equal retirement age for men and women
- unemployment below 5 percent
- 20 percent of the population in lifelong education
- 25 percent of students in engineering and technical faculties
- 4 percent of GDP for research and development
- 40 percent of scientists in the private sector
- 75 percent of the population in cities
- GDP in the poorest regions accounting for 60 percent of the EU average
- 100 percent of children in rural areas in kindergartens
- 20 percent increase in the employment of disabled people

more state funds into an anachronistic, uncompetitive and inefficient science and research system could only cause more problems. It would definitely fail to produce breakthrough discoveries in science and increased commercial application of inventions.”

Technology loans

Technology loans are a new form of supporting business projects. A total of 400 million euros worth of technology loans are available by 2015. A single applicant will be able to obtain up to 4 million euros to buy or develop a new technology, introduce it and launch production of new or improved goods and services. The money will be made available to micro-companies and small and medium-sized enterprises with innovative ideas confirmed by a research center or a science and technology association.

The loans are intended for investment in technology. Under the law, such investments include the purchase and launch of a new technology to produce new and upgraded goods and services.

The loans are available as part of structural funds under Operation 4.3 of the Innovative Economy Operational Program. A total of zł.200 million is available for this purpose in the second half of 2009.

According to Prof. Leszek Rafalski, chairman of the Main Council of Research and Development Centers,

innovative enterprises should be eligible for tax breaks in Poland.

EU funds

Bożena Lubińska-Kasprzak, chairwoman of the Polish Agency for Enterprise Development (PARP), says Poland is doing a good job absorbing EU funds for investment in innovation and the development of new technology and innovative projects. The Polish Agency for Enterprise Development distributes these funds among businesses, research and development centers, business-related institutions and universities. The agency has disbursed around zł.4.5 billion under almost 1,000 contracts for 2007-2013.

According to Alicja Adamczak, head of the Polish Patent Office, the number of patent applications is growing every year. The waiting time for a patent in Poland is now half the time needed for a similar procedure before the European Patent Office, Adamczak said. The maximum waiting time is four to five years, while fast-track proceedings take no longer than two years, she said.

Andrzej Smirnow, chairman of the parliamentary committee on science, says decision makers should make it easier for young people to build careers in science. The point is to encourage young people to become scientists, especially as 44 percent of the country's scientists with professorial titles are aged over 70, Smirnow says.

Piotr Bartosz

Award for Polish Scientist

Prof. Jerzy Leszczyński, a graduate of the Wrocław University of Technology in southwestern Poland, has won the prestigious U.S. Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM).



Leszczyński works at Jackson State University in the United States where he heads the Interdisciplinary Center for Nanotoxicity. He has authored 604 publications which have been cited more than 8,700 times.

Since 1999, Leszczyński has worked closely with the Chair of Molecular Modeling and Quantum Chemistry of the Faculty of Chemistry at the Wrocław University of Technology, a col-

Researcher Wins Plaudits

Iwona Gil, a Ph.D. student at the Silesian University of Technology in Gliwice, southern Poland, won the Topical Issues of Subsoil Usage international competition for young researchers in St. Petersburg, Russia, April 22-24. Gil's work may help reduce the greenhouse effect worldwide.

The competition, organized by the Russian education ministry and the St. Petersburg-based State Mining Institute, attracted more than 400 young researchers from 21 countries, including Austria, Britain, Germany, Canada, France, Hungary, Sweden, Iran, Finland, and the Czech Republic. A total of 259 works were submitted to the competition in nine categories.

Gil took part in the Ecology and Environmental Protection category as one of 60 contestants. Her work was dedicated to the effect of carbon dioxide on the methane combustion process involving flue gas recirculation.

Flue gas recirculation is a primary method for reducing nitrogen oxide emissions. Nitrogen oxides contribute to the greenhouse effect and the formation

of photochemical or sunshine smog and acid rain. Nitrogen oxides also affect human health. They cause hypoxia, or oxygen deficiency, in the human body, reduce its immunity to bacterial infections, and lead to pulmonary emphysema and allergic conditions including asthma.

As part of her research, Gil conducted experiments and used mathematical models. "The process I am dealing with takes place in high-temperature combustion chambers with inner induced flue gas recirculation," said Gil. "My work was based on introducing modifications into the Miller-Bowman methane combustion mechanism. It consists of a set of reactions that take place during methane combustion. I have updated the mechanism with four new reactions and changed the rate coeffi-



cient values of some of the reactions. In my experiments, I fed into the furnace a gas dilution composed of methane, oxygen, carbon dioxide and nitrogen and subjected all that to combustion in high temperatures. I analyzed the combustion reaction products in infrared. The analysis revealed that the Miller-Bowman mechanism modified in this way can be used for industrial system modeling. The model I have worked out will make it possible to simulate internal high-temperature combustion chamber processes."

Gil is a doctoral student at the Silesian University of Technology's Faculty of Materials Science and Metallurgy. The supervisor of her doctoral dissertation is Prof. Jerzy Tomczek.

Ewa Derefi

laboration that has yielded 112 joint publications in science magazines.

Leszczyński takes credit for an initiative that has resulted in an exchange agreement between the Wrocław University of Technology and Jackson State University. Under the agreement, 10 American graduate and postgraduate students from Jackson State University have obtained traineeships at the Wrocław University of Technology and over a dozen students and academic staff from the Polish university have spent time in the United States. Staff members and postgraduate students from the Wrocław University of Technology went twice to Jackson State University, in 2006 and 2007, to train professors from different American schools in the molecular modeling of biomolecules. The training program was commissioned by the U.S. National Science Foundation.

In 2001, Leszczyński received the Millennium Award for Teaching and Research Excellence in Mathematics, Science, Engineering and Technology from the U.S. president. Two years later, Leszczyński received an honorary degree from the State University in Dnepropetrovsk, Ukraine.

Since 2003, Leszczyński has been one of the organizers of a series of annual conferences entitled Modeling & Design of Molecular Materials and Biomolecular Interactions that are alternately held in Poland and the Czech Republic.

The PAESMEM program seeks to identify outstanding mentoring efforts that enhance the participation of groups—women, minorities, and persons with disabilities—that are underrepresented in science, technology, engineering, and mathematics. Award winners serve as leaders in a national effort to develop U.S. human resources in science, technology, engineering, and mathematics.

WATCHING DARK

Grzegorz Brona, D.Sc., a researcher at the University of Warsaw and co-owner of Creotech Ltd. company, talks to Piotr Bartosz.

● **Your company won a gold medal at the Innovation, Technology, Machines Poland 2009 trade fair in Poznań for the transfer of research results to business practice. What is it that you have transferred from the lab to the marketplace?**

The award went to a string of innovation and implementation processes, from the K20 and K30 cameras to systems based on Armputer and Armcamera technology. The K20 camera, developed for application in astronomy, is used to watch large sections of the sky and survey them for flashes. It was designed and manufactured in Poland and has turned out to be the most sensitive camera of its kind in the world. It is capable of watching dark stars. Last year, the Polish telescope "Pi of the Sky," fitted with K20 cameras developed in collaboration with the Creotech company, recorded the brightest optical flash ever seen by man in space. The phenomenon was identified as a gamma-ray burst. The findings of the observation and its significance have been described in Nature magazine, which is a great success for the research team.

● **Who are the team?**

The core of the Pi of the Sky team are graduate and post-graduate students and staff from the Andrzej Sołtan Institute for Nuclear Studies, the Center for Theoretical Physics of the Polish Academy of Sciences, the Institute of Experimental Physics of the Faculty of Physics at the University of Warsaw, the Institute of Electronic Systems at the Faculty of Electronics and Information Technology of the Warsaw University of Technology, the Faculty of Physics of the Warsaw University of Technology, the Faculty of Natural Sciences of the Cardinal Stefan Wyszyński University, and

the Space Research Center of the Polish Academy of Sciences. The team is led by Prof. Grzegorz Wrochna, Lech Mankiewicz, Ph.D., and Prof. Aleksander F. Zarnecki.

● **What role does Creotech play in the project?**

Parts of the "scientific" camera are used in closed-circuit TV cameras manufactured by Creotech. It is a spin-off company established by researchers from the University of Warsaw and the Warsaw University of Technology. The CCTV cameras needed to be made less complicated, because scientific applications necessitate top parameters. The basic idea, however, remains the same.

● **Who uses these systems?**

The Armcamera system is primarily used in surveillance. The camera houses a microcomputer that has been designed and manufactured in Poland. The microcomputer makes it possible to use Linux-type operating systems and so software for Armcamera can be easily written or replaced. The camera can count people passing in front of it, recognize faces and car license plates, and several cameras can work with one another. Think of a bank robbery where the first thing the robbers do is destroy surveillance cameras. That wouldn't do the trick with Armcamera, because the cameras are linked into a system and right before they were destroyed, they would send information on what they had just recorded to all other cameras in the bank. That protects the entire system from undesirable effects of external factors.

● **And what do astronomic cameras do in swimming pools?**

It is not the cameras, but the microcomputers used in them. Our first idea was to take the microcomputers out of the cameras to try and put them on the market as separate products. We have been introducing them together with a large Dutch holding company. This type of computer can be converted into a time server and so it can be used for air traffic control at airports. The microcomputers can also be used to control different processes in industry. Creotech has been introducing

STARS

one such product together with a company that designs swimming pool systems. The microcomputer is part of a controlling device in private pools equipped with temperature, pH and oxygen sensors. Data from the sensors is fed into a central unit fitted with a microcomputer and makes it possible to adjust the physical and chemical properties of the water.



● **Can a small company like yours successfully compete with business giants?**

Our microcomputers are much cheaper and more advanced technologically than their Western counterparts. By carving out a market niche, we managed to avoid a situation in which we would have to compete with large businesses.

● **Do you consider yourselves to be scientists or businesspeople?**

The founders of the company are teachers at the University of Warsaw and employees of the European Organization for Nuclear Research (CERN) in Geneva. We provide our services to research institutes and academic centers, including

the Polish Academy of Sciences, the Institute for Nuclear Studies in Świerk, the University of Warsaw, and the Warsaw University of Technology. We also work with a number of hi-tech companies in Poland and the West. A year and a half ago we decided to establish a private company based on knowledge and scientific research. By now we have gathered some experience and have several designers working with us. The entire production process is outsourced, while the company is focusing on developing its know-how.

● **How do you protect your work?**

There are two approaches to intellectual property management. The first approach is to be first on the market without patenting your designs, while the other approach is to patent your ideas and only then apply them in practice. During the initial phase, with start-up companies, money is always tight and patenting only makes sense if the patent is valid throughout Europe—which costs several thousand euros per patent—or even beyond Europe, in the United States, Japan and Russia, for example. We have chosen the first approach: to be first on the market without patenting our ideas. We do complicated things in small market niches—so complicated that copying our products simply does not pay off for large corporations that could potentially be tempted to do so. They are simply not interested in customers in these specialist markets. To a small company with limited funds, on the other hand, trying to copy systems of this kind would be too time-consuming.

● **Do you have any financial ties with the research centers you come from?**

The company has no financial ties with the schools, but we maintain friendly relations with the research centers. After all, we are still academics and we support research institutions with our knowledge and skills. At the same time, we draw ideas from the research we conduct there and use these ideas in our business operations. This is not competition, but two jobs that complement each other perfectly.



Polish Robot Praised in Utah

A Martian robotic vehicle designed and built by students from the Warsaw University of Technology won praise for its durable structure and quality from the organizers and judges of the annual University Rover Challenge 2009 (URC) competition of space exploration vehicles. This international competition was organized by the Mars Society on a desert in the U.S. state of Utah in early June.

The design, called Scarab, was the only European design entered for the competition. The Polish inventors competed against a number of American and Canadian teams who were "supported by extensive experience and academic and industrial centers that have taken part in many space missions," said Mateusz Józefowicz, chairman of Mars Society Polska.

According to Józefowicz, despite logistic problems, the project was "very well prepared" and demonstrated that Polish designers can offer competitive innovations. "We have also established good trade contacts and are going to take advantage of them," Józefowicz said.

The vehicle has been built by young designers from the Student Astronomical Circle and Mars Society Poland, in cooperation with institutions

including the Industrial Research Institute for Automation and Measurements (PIAP). The team who built the vehicle is made up of students from different departments of the Warsaw University of Technology: Sebastian B. Rodak, Daniel Śliwka, Jarosław Lasecki, Mateusz Wołski, Paweł Kasprowicz and Wojciech Głazewski. The vehicle took 18 months to build and cost zł.70,000.

Scarab is a remote-controlled Martian robotic vehicle provided with a camera and a grab mounted on a long arm. Its design is fully innovative and takes into account the environmental constraints with which the robot has to cope, the makers say, adding that the vehicle is able to cover large distances in difficult terrain and perform various tasks.

The University Rover Challenge competition is organized by the Mars

Society. It aims to select the best robotic vehicles that could be used to explore the universe in the future. The winners receive prizes and their robots are presented to NASA as potential designs for a Martian exploration vehicle. The annual competition is held in the Mars Desert Research Station, a simulated Mars base in a desert in the State of Utah.

"We have tried to enter our robot for the University Rover Challenge competition three times," said Wojciech Głazewski, a member of the Polish team. "This time we succeeded. We also hope to have a chance to take part in next year's competition."

Sebastian Rodak, who coordinated the project, said, "We are going to take part in the URC again next year, hoping to win."

Modeled after NASA's Mars exploration rovers, robots taking part in the competition had to perform four basic tasks: an emergency navigation task based on finding a lost astronaut and delivering emergency supplies to him; a construction task based on repairing a loose equipment panel by tightening several bolts; a site survey task based on spotting several distant markers and providing their exact coordinates; and a task based on searching for extremophiles, or bacteria that live in extreme conditions.

The Mars Society is an international organization that aims to promote the idea of a manned mission to Mars and Mars research. The organization brings together scientists; aerospace engineers such as Robert Zubrin, who has mapped out a plan for the colonization of Mars; astronauts like Buzz Aldrin, who took part in the first landing on the Moon; filmmakers like James Cameron; writers and other enthusiasts—all those who share the vision of human presence on Mars.

W.Ż.

RADIATION to Reduce Pollution

Polish nuclear chemists have come up with an idea to use radiation to treat flue gases generated by power plants.

The process removes sulfur dioxide and nitrogen oxides from the gases and the only by-product is inorganic fertilizer, which can be used in agriculture, say the researchers, who work at the Institute of Nuclear Chemistry and Technology in Warsaw.

A similar technology is used to purify plant and animal materials from microbiological contamination. According to the researchers, ionizing radiation is ideal when other sterilization methods involve excessive temperatures and when it is forbidden to add a specific sterilizing agent to a product.

In June, the Institute of Nuclear Chemistry and Technology unveiled its flagship application technologies at the Innovation Technologies Machines fair in the western city of Poznań.

A beam of accelerated electrons

One of the technologies is based on treating flue gas using a beam of accelerated electrons. The technology is designed to stimulate gas molecules, as a result of which pollutants are oxidized and enter a reaction with water vapor, forming acids that are then neutralized with ammonia. The process also eliminates volatile organic compounds. The solid product of the process is inorganic fertilizer, which is commercially used in vast quantities. Both pollutants—sulfur dioxide and nitrogen oxides—are thus simultaneously removed in a dry process. The technology makes it possible to remove 98 percent of the sulfur dioxide and up to 70 percent of the nitrogen oxides from flue gases. The irradiation process is conducted in two stages. The installation treats flue gases produced by two boilers, each with a capacity of 65MW.

The project manager is Prof. Andrzej Chmielewski, D.Sc., director of the Institute

of Nuclear Chemistry and Technology. For around seven years, the technology has been applied on an industrial scale at the Pomorzany Heat and Power Plant, part of the Dolna Odra Power Generation Group, in Szczecin. The research-and-industry installation was launched under a contract between the International Atomic Energy Agency in Vienna and the governments of Japan and Poland and built as a joint project with the Energy Management and Conservation Agency (EMCA). It is the only installation of its kind in the world.

Investment and operating costs are around 20 percent lower than in conventional processes. This is particularly important in the case of installations built in existing power plants. Although the Polish technology is cheaper, its application would require power plants to invest a lot of money and give up traditional technologies currently in use.

Most traditional methods have been developed in Germany. Popular flue gas treatment technologies include the wet method, which removes sulfur dioxide and produces gypsum.

Radiation without radioactivity

The Center for Radiation Research and Technology is managed by Zbigniew Zimek, D.Sc., while the head of the Radiation Sterilization Laboratory is Iwona Katuska.

The Institute of Nuclear Chemistry and Technology is the only facility in Poland to conduct radiation ster-

Medical products and plant and animal materials which undergo radiation processing are toxicologically and bacteriologically safe and retain their properties. The researchers say radiation sterilization does not induce radioactivity in the irradiated product. High-energy electron radiation is also used to sterilize surgical clothes, blood transfusion kits, gynecology kits and microbiological equipment. The institute provides its services to four tissue banks, which use the method to sterilize bone, cartilage and skin grafts. On a smaller scale, the process is used to sterilize therapeutic products, cosmetic preparations and their components.

Whether medicines can be sterilized through irradiation depends on their radiation immunity. Tablets, powders, pastes, ointments and suspensions are less vulnerable to radiation than solutions. Radiation sterilization is less commonly applied to final therapeutic products than raw materials.

Since plant and animal materials frequently contain high amounts of microbiological impurities, ionizing radiation is practically the only acceptable sterilization method, according to the researchers. Other methods necessitate either temperatures that are too high for this kind of products or employ sterilizing agents that are not recommended for use with such products.

Radiation sterilization is an efficient method, the researchers say, because ionizing radiation kills pathogenic microorganisms by causing irreversible damage to the cell membrane and disturbing replication. The main advantages of the method include

its simplicity (repeatable parameters, easy monitoring and precise quality control), sterilization conducted at room temperature or lower, and a fast sterilization process. This method can be used on any batch of products and employs totally hermetic packaging, which rules out recurring contamination and makes products safe to the environment, the researchers say.



RADIATION SAFETY

ilization involving a stream of high-energy electrons, produced by the Elektronika 10/10 accelerator.

The station has been in operation for 20 years.

Piotr Bartosz

Helping Children With Heart Disorders

Researchers at the Foundation for Cardiac Surgery Development (FRK) in the southern city of Zabrze have built a prototype device to help children with severe heart problems.

The device, modeled after a similar product for adults, gives time to an ailing heart to regenerate and, if regeneration is impossible, extends the life of the patient while he or she waits for a heart transplant.

The ventricular assist system for adults has been used successfully for over a decade and has helped more than 200 patients, the researchers say. The device for children is intended for pint-sized patients with severe circulatory failure and weighing from 20 to 40 kilograms.



The foundation's Artur Kapis (pictured), who heads the project to build a heart assist device for children, says it is not enough to reduce the size of the device already used in adults. The device intended for children

also needs to be adapted to pumping a smaller volume of blood, for example.

If they have enough money to press ahead with their project, the researchers say they will soon make laboratory tests on the prototypes they have built. Later this year or early next year, they plan to start experimenting with the use of real blood and then launch tests on animals.

Small but mighty

The POLVAD-PED pediatric device built in Zabrze was developed to supplement the POLVAD heart assist device for adult patients, which has been in successful clinical use since 1996. It is used by six Polish cardiac surgery centers, and has helped 207 patients so far.

Encouraging treatment results in adults led the foundation's engineers to start working on a smaller device. Most diseases where heart assist devices are used, such as myocarditis, also occur in children and teenagers. A pediatric system was requested specifically by doctors from the centers that use the adult version.

The experience gathered while working with the device for adult patients helped speed up work on the prototype of a pediatric device. The Foundation for Cardiac Surgery Development started the project in 2008; the prototype for children was ready in February this year. Specialist laboratory tests and experimental testing on animals will last until January 2010. The designers hope that the pediatric heart assist device can be used as a standard method in treating extreme cardiovascular problems from the end of 2010.



"Building a device for children does not mean a simple reduction of the adult device," says Roman Kustos (pictured), head of the foundation's Artificial Heart Laboratory. Apart from its smaller size, which enables it to be connected properly to a child's vascular system, the pump also has to have a smaller capacity. In adults, it pumps about 5 liters of blood per minute, in children this has to be 2.5-3 liters. The pump is designed for a certain nominal flow at which it operates safely, meaning that all the pump's parts are optimally washed with blood and the blood flows through safely, ensuring minimal risk of clotting in the device, Kustos says. Clotting is the greatest hazard faced by

HEART IN THE RIGHT PLACE

Polish researchers are at the forefront of a worldwide effort to design innovative artificial ventricles to assist the heart, and they are also working on an artificial heart implantable into the patient's body.

The PolVAD ventricular assist device, developed by researchers at the Foundation for Cardiac Surgery Development in Zabrze is an innovative design that has won some major awards, including the Grand Prix at the 53rd Brussels Eureka World Exhibition of Innovation, Research and New Technology in 2004, and a Gold Medal at the 104th International Concours-Lépine invention show in 2005 held as part of the Foire de Paris international fair.

Other devices developed at the foundation's Artificial Heart Laboratory have also won international awards. Among other designs, the Zabrze specialists have developed a pneumatic system for mechanical circulatory assistance, POLCAS, which won plaudits at the 5th European Forum of Competitive Technology TEC'96 in Grenoble, the 2nd Techno Messe Kansai in Osaka in 1997, and the Intertechnology'98 fair in Łódź. The POLHIVAD, a prototype of a fully implantable electrohydraulic left ventricular assist device, claimed a gold medal at the 6th London International Inventions Fair in 1998. The device enables long-term treatment of heart failure and secures the time needed for pharmacological therapy or the selection of an optimal organ for transplantation.

patients with a heart assist device. For smaller patients, the pump has to be different not only anatomically but also functionally.

The POLVAD-PED device, like the adult heart assist device, can be implanted as a left-, right- or bi-ventricular device, the researchers say. It is made wholly from biocompatible polyurethane and is fitted with two one-disk mechanical valves. It is powered pneumatically, by a drive that is also the foundation's original project—the same kind that is used in the adult device.

Engineering work on the prototype was conducted using advanced CAD methods and computer flow simulations. It involved three stages. In the first stage, the device's parts were designed in several versions, the best of which was then chosen in blood flow simulation tests.

A range of devices

The POLVAD-PED device is meant for children aged 7 to 12 and weighing between 20 and 40 kilograms. Younger children, including infants, would need an even more complicated device, and though the Foundation for Cardiac Surgery Development does not rule out such a project in future, there are no official plans as yet. Even so, expanding the range of Polish heart assist devices to include an even smaller version seems to be a natural continuation of the current work, the researchers say.

"Heart surgeons keep asking about an assist device for very small patients, even babies," Kustosz says. "There's no question that such devices are needed clinically. German-made pumps of this kind exist, but they are unimaginably expensive. Meanwhile, our team has the know-how and the potential to develop a device for infants that would be unique in Europe and beyond. I think if funds could be found, the foundation could relatively quickly design a whole range of heart assist devices, starting with one for newborns."

At present the foundation is working on its own design for a valve for heart assist devices. The idea came from Dr. Jacek Moll from a heart surgery clinic in Łódź; the designers from Zabrze have been working with him for many years. "This project has been in the pipeline for some time, but the technology enabling it to be implemented surfaced only recently," Kustosz says. "After recent progress in materials engineering we can now return to this idea. Once we outfit the heart assist devices with the new valve, they will gain a competitive edge on the global market."

Clinical practice

The devices built at the Artificial Heart Laboratory are part of the POLCAS heart assist system designed by the foundation. This includes not only building heart assist devices but also supporting their clinical application. The device's designers train medical personnel, run clinical projects to develop increasingly better treatment methods and effectively eliminate the risk linked to clotting within the devices. All this means continual development of treatment methods involving heart assist devices. As a result, heart assist devices are used today both as an aid in heart transplants and, increasingly often, as assistance in heart regeneration; that means they stay implanted in the patient for a long period of time. A few years ago, the



Heart assist device for adult patients (POLVAD) and a similar device for children (POLVAD-PED)

average time a heart assist device implant stayed in a patient was three to four weeks. Today the typical period is two to six months; the longest time it has operated in a patient is 204 days. Today heart assist devices are used to treat the heart—by giving it time to regenerate, which often means that a transplant can be avoided.

Today, about 100 POLVAD devices for adult patients are manufactured per year. The maker is a technology company established by the Foundation for Cardiac Surgery Development; the company also deals with distribution and maintenance of heart assist systems. All the output goes to the domestic market and meets the needs of Polish clinics. The foundation has plans to increase production with a view to entering foreign markets as well.

The design work on the POLVAD device—from project commencement to the first implant—took eight years. Work on the prototype for the POLVAD-PED pediatric device lasted just one year. Kustosz says that production and then experimental clinical application of the latter device will be launched in 2010. In addition to Kustosz, the team that developed the pediatric device comprises Artur Kapis, who is the project's manager, Maciej Darlak, Wojciech Bujok, Agnieszka Szuber as well as Bogdan Stolarzewicz and Sebastian Stolarzewicz from Plastmed company.

Work on the POLVAD-PED device has been financed from the Foundation for Cardiac Surgery Development's own funds and from a public collection for projects involving heart assist devices.

Ewa Dereń
photos by Mariusz Jakubowski
Foundation for Cardiac Surgery Development

Clean Coal— An Opportunity for Poland

Clean coal technology is the new challenge for Poland's energy sector as the country strives to meet international environmental standards while continuing to use coal, its main source of energy.

Electricity consumption forecasts for Poland show there is a need to expand the country's power generation capacity. On the one hand, Poland's obligation to cut greenhouse gas emissions forces it to use low-emission electricity generation technology. That is why the country plans to make use of all available coal-based energy generation technology that helps reduce air pollution and significantly cut carbon dioxide emissions.

An Economy Ministry draft energy policy until 2030 calls for supporting the development of energy generation technology with a reduced environmental impact, including coal gasification and carbon capture and storage technologies.

Nearly 95 percent of electricity in Poland is generated by coal-based power plants. This ensures a high level of energy security, but requires increasingly expensive pollution reduction methods due to systematically decreasing emission limits. That is why, experts believe, clean coal technology should be a natural step in the development of the Polish fuel and energy system.

CCS is key: Buzek

Carbon Capture and Storage (CCS) is a major opportunity for Poland, says Jerzy Buzek, former Polish prime minister, now president of the European Parliament, who specializes in envi-

ronmental protection and the energy industry. He believes that increasing the role of renewable energy and investment in nuclear energy will not eliminate the Polish energy system's dependence on coal.

"We will not produce electricity from oil and natural gas because we do not have sufficient deposits," Buzek said in an interview for the Polish Press Agency. "We are left with renewable energy, nuclear power and coal. Nuclear

energy will be here in 15 years at the earliest, while renewable energy is expensive. We should develop both, but these sources will generate a total of only 30-40 percent of our energy; the remaining 60-70 percent must come from coal."

Clean coal research in Poland focuses on technology and development forecasts. Technology is developed at the Central Mining Institute, the Institute for Chemical Processing of Coal and the Institute of Power Engineering. Forecasts are provided by the Energy Market Agency, which develops the guidelines for the country's energy poli-



Waldemar Pawlak

cy, and by the Polish Academy of Sciences' Mineral and Energy Economy Research Institute, which works on development forecasts for power and heat generation technology.

Of particular importance is research on underground coal gasification technology, and carbon dioxide capture and underground storage, experts say.

From words to action

According to Waldemar Pawlak, the deputy prime minister and economy minister, Poland is the best country to implement clean coal technology because it is dependent on coal as a source of energy. "That is why we want to launch at least two carbon capture and storage installations in the near future," he said.

Speaking at a recent conference on CCS and other clean coal technology, held by demoseurope earlier this year in Warsaw, Pawlak said, "Along with growing energy generation costs, including carbon dioxide emission fees, we are approaching a point where new technology is becoming economically viable on a large scale. That is why we also need CCS test installations, in order to examine their efficiency and economic value."

The development of clean coal technology is supported not only by Poland, but also by European Union officials in Brussels. The EU plans to spend significant money on the construction of 12 test CCS installations throughout Europe by 2015.

Not as black as painted

Buzek says the EU has changed its attitude to coal. Until recently coal was seen as undesirable and environmentally unfriendly. Now Brussels sees it as a priority. "The EU believes that coal may be a source of energy for many decades," says Buzek. "It's available in nearly all EU countries and there is no need to import it. The plan to make billions of euros available for the development of clean coal technology underlines the importance the European Commission attaches to this raw material."



Jerzy Buzek



‘Intelligent’ Coking Plant

Researchers in the southern city of Zabrze have set out to develop a technology to produce high-quality coke in an “intelligent coking plant.”

More than 50 companies, including Polish firms, have shown interest in building CCS installations. The Elektrownia Bełchatów power plant, part of the Polish Energy Group, is hoping for a subsidy from EU funds to build a CCS system. The company is building an installation along with an 858 MW lignite-fueled energy generation unit. The plant has signed a letter of intent with French company Alstom on the development and launch of a CCS installation. In phase one, Alstom will design and build a test installation for an existing power unit. It should be launched in mid-2011. Next, experience gained from operating it will be used in the construction and operation of a CCS installation at the new unit.

Zakłady Azotowe Kędzierzyn is also counting on EU support. The company intends to build, jointly with Południowy Koncern Energetyczny energy group, an installation that will not only capture carbon dioxide but also allow it to be used for methanol production.

In its demonstration phase, the project will generate enough synthesis gas to produce 500,000 metric tons of methanol a year. This will meet the entire domestic demand for methanol, eliminating the need for imports, officials say.

Most experts agree that clean coal technology offers good prospects. However, industrial-scale application of the CCS technology in Poland may be hampered by the fact that, for the time being, the country has no laws regulating carbon dioxide storage underground.

A.R.

The researchers want to come up with tools that will upgrade the process of producing coke by making it more efficient, environmentally friendly and safe.

The Institute for Chemical Processing of Coal in Zabrze is coordinating the project, which was launched in May at a meeting of scientists and industry professionals at Zabrze’s Coal Mining Museum.

The Intelligent Coking Plant project aims to develop tools, procedures and products that will increase the competitiveness of coke production and reduce the negative environmental impact of coking plants.

The Intelligent Coking Plant is a key research project being carried out under the Innovative Economy Operational Program for 2007-2013. The project will be 85 percent financed from the European Regional Development Fund and 15 percent from domestic public funds. It is among the country’s largest projects involving collaboration between science and industry.

The Institute for Chemical Processing of Coal in Zabrze is a prime research center for Poland’s coking industry with a tradition going back more than 50 years.

The research also involves scientists from the AGH University of Science and Technology in Cracow, the Silesian University of Technology in Gliwice, the Institute of Fluid Flow Machinery of the Polish Academy of Sciences in Gdańsk, and the Central Mining Institute in Katowice. Industrial plants interested in joining the project include Koksownia Zdziezowice (ArcelorMittal group), Koksownia Przyjaźń (Jastrzębska Spółka Węglowa group), Kombinat Kokschemiczny Zabrze, Jastrzębska Spółka Węglowa, and Kompania Węglowa.

Poland is among the world’s top 10 producers of coke and the second-largest exporter after China. The country’s coking plants produce more than 11 million metric tons of coke per year. Over half the output is exported.

INDUSTRIAL TRADITION

The Coal Mining Museum in Zabrze, which hosted the launch of the Intelligent Coking Plant project, is part of Silesia province's Industrial Monuments Route, one of the region's greatest sightseeing attractions. The route features 31 selected sites of unique historical value.

The region of Silesia in southern Poland comprises the country's largest cluster of historical industrial sites that testify to Silesia's wealth as an industrial region and its role as an important part of Europe's cultural heritage.

Historically, Silesia developed as a result of industrialization that began in the 18th century, with smelting furnaces, mine shafts and power plant chimneys becoming permanent fixtures in the landscape. Reminders of those not-so-distant times include facilities linked to mining, metallurgy, power engineering, food processing, railroads, communications and water supply.

The Industrial Monuments Route has been designed to highlight the facilities' attractiveness as tourist sites. Tours of the individual sites reveal unique machines and equipment that are gems of technology. One of the aims of the route was to use excursions and multimedia presentations as well as various events organized at particular sites as a means of personally experiencing the industrial tradition of Silesia.

In addition to the Coal Mining Museum in Zabrze, the most fascinating sites of the Industrial Monuments Route include the Tychy Brewing Museum; the Brewery and the Brewing Museum in Żywiec; the Bread Museum in Radzionków; the Guido Historical Coal Mine in Zabrze; the Match Production Museum in Częstochowa; and the Nikiszowiec Workers' Housing Estate in Katowice. The Coal Mining Museum in Zabrze houses a working steam engine from 1915. Each facility is marked with a plaque containing information about the site in three languages plus practical tips for tourists. Silesia province has put up a total of 305 special brown-and-white road signs informing travelers how to get to the 31 historical sites.

Beyond 2013

The Intelligent Coking Plant involves laboratory research and experiments at coking plants. The project is expected to yield a number of new technologies that will be applied in coking plants after 2013. The aim of the project is not so much to change the coking process, but to develop tools that will make it more efficient, environmentally friendly and safe, the researchers say. These will include tools from fields such as information technology, process control and automation.

The project involves five research areas: physicochemical processes of coal conversion;



COKE IS IT

Coke is a hard gray fuel with few impurities and high carbon content that is used worldwide in blast furnaces to make metals. Coke is made from bituminous coal in a process that generates by-products including ammonia, coal tar, and gaseous compounds.

efficiency-oriented processes and operations; optimal technological systems; environmental safety; and integrated operation and control.

Research into environmental issues is an important part of the project. This especially applies to waste water management and air pollution.

The project manager is Aleksander Sobolewski, PhD Eng., a scientist with experience in coke engineering and deputy director for research and development at the Institute for Chemical Processing of Coal.

Ewa Derefi



YES TO NUCLEAR POWER

Under a long-term energy policy drawn up by the economy ministry, the Polish government is determined to press ahead with a nuclear power program. Early this year it approved a resolution whereby Polska Grupa Energetyczna (PGE) energy corporation will build one or two nuclear power plants in the country by 2020.

In terms of legal regulations, Poland is prepared for the development of nuclear power engineering, experts say. The public's attitude to nuclear power is also changing. Surveys show growing support for a nuclear power program in Poland now that memories of the 1986 Chernobyl disaster in neighboring Ukraine have faded.

Nuclear Merger on the Agenda

The government is thinking of merging two institutes dealing with atomic energy to establish a single Institute for Nuclear Research in Świerk near Warsaw.

The Institute for Nuclear Research would be established through a merger of the A. Soltan Institute for Nuclear Studies (IPJ) and the POLATOM Institute of Atomic Energy (IPA), said Hanna Trojanowska, the government's commissioner for nuclear power engineering.

Trojanowska met with researchers and industry professionals in Świerk in early June to talk about the need to develop modern research facilities for the nuclear energy sector. Other topics included training programs for staff and the need to carry out a large-scale public awareness campaign to put in a plug for the government's nuclear energy program.

The Institute for Nuclear Research would be home to state-of-the-art research equipment, including the POLFEL Free Electron Laser and a

helium loop used for research on high-temperature reactors. This equipment, purchased for funds from European Union coffers, would be used not only by physicists, but also by researchers and engineers in other fields of study, experts say.

Today the Astrophysical Apparatus Laboratory of the Institute for Nuclear Studies holds research devices such as those used in the "Pi of the Sky" project that yielded the world's first "film" from the birth of a black hole. The equipment had been designed and built at the laboratory.

The Institute of Atomic Energy includes facilities such as a "hot chamber laboratory" with stations for monitoring and examining radioactive materials. The institute's PolAtom Radioisotope Center features a production line that meets most of the domestic demand for radiopharmaceuticals, according to the institute's director, Prof. Krzysztof Wieteska.

"The two institutes have enormous potential for development," said Prof. Grzegorz Wrochna, director of the Institute for Nuclear Studies. "The Institute for Nuclear Studies is a top Polish research facility according to the Hirsch index."

The facilities in Świerk have survived even though funding for nuclear research was radically cut in the 1980s after decision makers abandoned a plan to build a nuclear power plant in Żarnowiec in the north of the country. According to Wrochna, Świerk has survived all those difficult years thanks to the passion of its scientists and continuing cooperation with the best research centers in Europe and beyond.

P.B.

The university was founded in 1919 and trained 797 engineers and steelworkers before World War II broke out. It has produced a total of 150,000 engineers to date. Currently, the school offers 29 courses and 170 specializations. The university campus comprises the Interfaculty School of Energy and the Interdisciplinary School of Biomedical Engineering. The latter was founded in 2006 as the first establishment of its kind in Poland. More than 500 people are enrolled in PhD studies at the university, and 2,300 in postgraduate courses.

The key department is that of Electrical Engineering, Automatics, Computer Science and Electronics, with 5,000 students, and the most popular courses are computer science, automatics, robotics and telecommunications. Another popular department is Mechanical Engineering and Robotics. According to the Polish State Accreditation Committee, this is the best university department training specialists in mechatronics, mechanical engineering and machine building in this country.

Road to a career

"Our students are well prepared to work in industry," says the deputy rector for education, Zbigniew Kałol. Employers, both Polish and foreign, are happy to hire AGH graduates, he adds.

The university is involved in many research projects, including work on an artificial cardiac valve, regeneration of bone tissue and composites for making prostheses. Last year, a total of 2,180 research projects were in progress at AGH.

"In addition to mining and metallurgy, we educate students in fields such as robotics, automation, computer science, telemedicine, technical physics, applied mathematics, management, sociology and cultural studies. In other words, we are not just a technical school but one that also teaches humanities," says Kałol.

The school's curriculum is flexible and adapted to market needs, Kałol says. AGH students can count on scholarships from companies such as oil corporation Lotos, copper producer KGHM Polska Miedz, power company RWE, and global energy and automation technology giant ABB.

Specialists in mining (270 first-year students enrolled) and metallurgy (180) are still essential to the economy. One cannot build a tunnel, subway line, freeway or even foundations and garages under high-rise buildings without people who are qualified mining experts. Today's metallurgy is different, too. It involves advanced technology and state-of-the-art materials. Industries such as aircraft and car manufacturing need light, unbreakable, durable alloys and composites. Materials engineering and metallurgy are a serious challenge today.

Despite a population decline and the overall smaller number of applicants for college courses in Poland, the number of applicants for AGH courses is growing. Rector Prof. Antoni Tajduś says that when he was appointed in 2005, there were 4,500 first-year students. Today there are 7,000.

The single most popular course is sociology at the Humanities Department, which was launched in 2001 in response to changing social and economic requirements as a



SCIENTIFIC MINDS

With 33,000 students in 15 departments and more than 2,000 teachers, the state-run University of Science and Technology (AGH) in Cracow is number two among Poland's technical schools of higher education. The university is marking its 90 years this fall.



result of globalization. There were 10 candidates for each place.

Teachers with a difference

The university relies on its own staff of computer scientists and applied mathematicians familiar with modern software and IT tools. The teaching staff also includes scholars from the Polish Academy of Sciences, philosophers, political scientists, cultural scientists and historians.

AGH is Poland's first university with plans to launch a Fuels and Energy Department. It will replace today's Interfaculty School of Energy as of October. AGH has a large number of specialists in energy raw materials, renewable energy sources and even nuclear power engineering. The university coordinates the Energy Sector Knowledge Hub as part of the European Union's Knowledge and Innovation Hub currently under development.

Courses such as power engineering and chemical technology are an attractive option for young people who want to find a rewarding and well-paid job in the future, AGH managers say.

AGH says it has the best-developed biomedical engineering curriculum among Polish universities. The curriculum is based on a solid tradition, as research on problems involving technical support for medicine, biomechanics and biomaterials began here in 1973. The first syllabus in Biomedical Engineering was designed by Prof. Ryszard Tadeusiewicz. Today there are six candidates for every place at the Interdisciplinary School of Biomedical Engineering (MSIB), but only the best 150 are admitted.

"We are starting a new specialization as of October: bionanotechnology," says AGH's spokesman Bartosz Dembiński.

The Interdisciplinary School of Biomedical Engineering is a shared project by the departments of Electrical Engineering, Automatics and Electronics (in the field of advanced computerized diagnostic and therapeutic equipment and artificial organs), Materials Science and Ceramics (biomaterials and biocompatible materials used in medical implants, for example) and Mechanical Engineering and

Robotics (engineering biomechanics, bioacoustics, bioengineering design, implants and prostheses, orthopedics, and biomedical equipment).

At home and abroad

AGH enjoys a solid reputation abroad. It hosted last year's World Mining Congress and the 16th International Congress on Sound and Vibration, an event that attracted over 800 participants from around the world. The European Network of Mining and Metallurgy was launched at AGH. The conference "Problems of Education and Scientific Research in Mining and Metallurgy," held at the university a few years ago, was attended by 56 rectors and deans representing 16 universities from 11 European countries.

International cooperation means contacts with universities and research centers, but also active membership in various organizations, such as ACRU (Association of the Carpathian Region Universities), EUA (European University Association), IAU (International Association of Universities), SEFI (Société Européenne pour la Formation des Ingénieurs), and AEUA (Arab and European Universities Association).

AGH covers over half of its running costs by itself, making money on research, design and practical application of its inventions. It has signed 120 contracts with various companies, including corporations such as IBM, Google, Microsoft, Delphi, ABB, Motorola, Orlen, Lotos, Jastrzębska Spółka Węglowa, Comex, Górażdże Cement, Geofizyka Kraków, Woodward, Katowicki Holding Węglowy, and Tauron.

The university attracts many foreign students from countries such as China, Vietnam, Mexico and Ukraine. Over 100 foreign students will come to AGH in the upcoming academic year. Most of them want to study at the departments of Electrical Engineering, Automatics and Electronics, Mechanical Engineering and Robotics, and Materials Science and Ceramics.

A state-run university, AGH does not set up courses specially intended for foreigners. Every department has a set



of subjects available to foreigners, allowing students to “design” their own course individually.

The Bologna system of education, which aims to develop a European space for higher education, also benefits students. AGH students can spend a semester or more at universities in other countries, chiefly in Spain (including Palencia), France (including INP Grenoble), Germany (Freiberg, Clausthal), and Norway (Trondheim). In the previous academic year, 170 students went abroad, and 235 will follow suit next year—206 to study and 29 going on traineeships. Student exchanges are based on European Union projects such as Leonardo da Vinci, TEMPUS, Culture 2000, eTEN, Research Fund for Coal Steel, the Visegrad Fund, and the Co-Tutelle scholarship

program of the French government as well as scholarships under the trilateral Trondheim-Leipzig-Freiberg agreement.

Not only students but also scientists from AGH visit foreign universities. Last year they made 2,500 visits involving conferences, grants, exchange programs and research to countries such as Germany, France, China, Japan and Mexico.

AGH’s research and teaching staff enjoy good conditions of work and career development, with strong research teams and more 600 laboratories on the premises. The university staff’s earnings are one of the highest among scientists in this country.

Teresa Bętkowska

INTELLECTUAL PROPERTY

Protecting Scientists’ Achievements



Józef Modelski (pictured), director of the Warsaw University of Technology’s Institute of Radioelectronics.

Modelski is also director for Europe, the Middle East and Africa at the Institute of Electrical and Electronics Engineers (IEEE), an international organization that brings together almost half a million specialists in electrical engineering, electronics, telecommunications, IT, nuclear and medical electronics, and space technology. The IEEE runs many periodicals from the Philadelphia List and organizes major international conferences.

The key to a competitive economy

Modelski is directly involved in problems that were discussed at the 2nd International Intellectual Property Management Forum in Warsaw and Cracow in March. The forum, entitled “IP Management: The Key to a Competitive Economy,” featured a number of conferences and symposia that attracted many foreign researchers experienced in working with industry and academics from the world’s best universities that have blazed the trail in transferring inventions to business.

During the event they shared their experiences with their Polish colleagues.

“Intellectual property management is one of the most important topics in the world today,” Modelski says.

According to Modelski, Poland’s greatest asset is the huge potential of knowledge represented by Polish scientists and the creativity of its research and academic centers. Its weakness, on the other hand, is a historically determined absence of the habit or tradition—of the kind that has developed in the West—of turning this knowledge into a patent and getting it implemented. Another problem, Modelski says, is a mistaken policy of the government, which keeps financing all sectors equally just like the state did under communism, instead of selecting and supporting fields that are of key importance to Poland’s development.

“What’s the point of patenting something in Poland, on a very confined user and buyer market? We should strive for European patents, which cost money, true, but offer a chance for greater profits,” Modelski says. “Key projects have to be launched on the international market. Though only a small percentage of patents are a commercial success, unless

Polish scientists are learning the ropes of intellectual property management.

Today the whole world is bending over backwards to make sure that intellectual property is properly utilized, promoted and protected, says Prof.

you keep trying you stand no chance of success. It's the same all over the world, only a few percent of good ideas find business applications. There is no other way than to take that risk."

Bigger budget needed

"To put the results of their research to commercial use, universities need much bigger budgets," says Modelski. "They also need to know how to put this money to a good use. Universities should only pay for patents that pass the test on the market."

According to Modelski, people who make decisions on funding for industry should focus on developing innovative products—"something like a Polish Nokia"—and invest in the development of selected sectors.

"Nearly every scientist committed to their work thinks their field is the most important," Modelski says. "Government institutions, however, have to be objective and make a realistic assessment of projects that research centers offer for practical use. Naturally, I promote my own field, and within it—the development of wireless sensors. But I have to give priority to information technology and bioengineering. Those working in these fields are implementing their ideas all over the world, including highly developed markets."

Poland lacks a long-term vision of development, says Modelski. Scientists can tell politicians what they think is important. However, it is independent experts grouped in interdisciplinary teams who should prepare analyses and choose the "gems" in which it is worth investing money in order to recoup it many times over later, Modelski says.

Many research projects in Poland are commissioned by industry. Problems with technology transfer are not exclusively the fault of scientists who do not implement their technologies, Modelski says. "Neither is it just a matter of funding shortages at universities," he adds. "Industry in Poland is poor as well; in some sectors, Western consortia treat us as nothing but a sales market. The only way out of this tough situation is to choose sectors that could form the foundation of a knowledge-based economy in the future."

PATENT PROTECTION

A patent is an essential business tool in today's marketplace where the rule of thumb is that a good product will always get copied, experts say. This affects trademarks as well as innovative designs and technology. Patent protection is designed to eliminate copying and unfair competition.

"The process for registering a patent in Poland is currently the same as elsewhere in Europe because our law for the protection of industrial property has had to comply with the European standard ever since Poland joined the EU," says Grażyna Padee, a spokeswoman for the Polish Patent Office. "However, without a doubt a problem exists in Polish firms' lack of understanding of what protection of industrial property means and of its importance. Because of this lack of understanding, they are reluctant to embark on what is an unusually complicated and long procedure to obtain ownership rights."

Patents in other countries are usually more expensive than in Poland, according to Padee. The decision to patent a product abroad must be based on a profound analysis of risk and profitability. Besides countries' own patent offices, there is also the European Patent Office, which acts on notification from the country in which rights to a given product are to be protected.

Flagship sectors

There are many strong fields of science and industry which could become Poland's flagship sectors with increased funding, according to Modelski. Polish IT specialists are a powerful force, setting up many new companies in recent years. Polish engineers have also pushed through many ideas and implemented them all over the world, also on highly developed markets. Biomedical engineering is another area worth investing in, Modelski says.

The Warsaw University of Technology's Institute of Radioelectronics, of which Modelski is head, has maintained close cooperation with industry for many years. Modelski's research interests have long focused on microwave technology, radio communications and television. According to Modelski, investing in these areas is risk-free and profitable.

Scientists from the Warsaw University of Technology's Institute of Radioelectronics are working on radar systems for both civilian and defense applications, Modelski says. The teams of Prof. Stanisław Rosłonec and Prof. Tadeusz Morawski are closely working with the Telecommunications Research Institute (PIT). The institute's products are sold on international markets, including Asia. The greatest achievements in cooperation with external companies are those of Wojciech Wojtasiak, PhD Eng., whose team is working on advanced transceiver components. A few years ago, a team led by Prof. Wojciech Gwarek developed some advanced software with electromagnetic simulators that was sold to the world's leading companies from the sector, Modelski says. In this case, the technology transfer resulted in the establishment of a spin-off company by university employees.

P.B.

Archeological Finds in Silesia

The remains of a complex of medieval wells that supplied water to residents but also served as coolers have been discovered during construction work in the center of Bytom, a city in the southern Silesia province.

Archeologists found the first well-preserved remains of 15th-century infrastructure in early May. Initially, they thought that the uncovered timber structure was a small shaft for mining silver and lead ore, but it later turned out this was a well. There are more similar wells in the vicinity. They were once built to supply the townspeople with water.

In all, the archeologists have found four wells. Two of them are special, they say. Apart from well-preserved side walls, one well had a timber bottom with no vertical corner piles to support the structure from the inside. Inside the well, the archeologists came upon a large wooden bucket with a handle, a wooden winch, and a clay mug for drawing water.

Another well, which at first glance looked ordinary, contained animal bones. Deeper down, archeologists found some excellently preserved clay jugs covered with enamel and remnants of string around the handles. This suggests that the well may have been used as a cooler, the archeologists say; the jugs were probably filled with food and placed deep down where the temperature was low.

Preliminary studies show that the wells were built between the mid-14th and the end of the 15th century. Their depth ranges from 6.5 to 8 m below the present street level. One more well, lying outside the historical town walls, remains to be investigated.

Digs in Syria

A group of Polish archeologists headed by Prof. Rafał Koliński from the Adam Mickiewicz University's Institute of Prehistory in Poznań have unearthed several tombs dating to the Khabur period (1900-1750 BC) in the ancient city of Tell Arbid, Syria.

Two of these are hollow structures with a barrel vault. Leading into the

tombs were two-meter shafts in which the people of the time placed their dead, the archeologists say. The shafts were protected from landslides by walls built above the tomb's entrance.

In another burial ground from a similar period, scientists have finished studying two box graves covered with a row of vertically standing mud bricks. Bone remnants were found in both. Only one grave contained a large set of jewelry, including bronze pins, over 100 beads and a ring.

The discovery of another burial ground came as a surprise. The archeologists have identified one chamber tomb and several vessel tombs. The shaft leading to the former contained an anatomically arranged skeleton of a dog; the animal may have belonged to one of the people buried in the grave.

More excavation work is being conducted in a post-Adian settlement dating back to the 21st century BC. The studies are focused on a large building whose walls are covered with reddish clay plaster. The floor has miraculously survived undamaged, the archeologists say. Among the most interesting finds is a bronze sickle with a cuneiform sign carved in its blade.

Geophysical Studies of Ancient Pelusium

Polish archeologists are conducting excavation works combined with electrical resistance tests and magnetic studies in the ancient city of Pelusium, Egypt.

In the Greek-Roman era, Pelusium was the second-largest seaport after Alexandria. It was home to a stronghold that guarded the eastern border of the land of the pharaohs. The city was located at the northwestern edge of today's Sinai, along the route of caravans making their way to Egypt.

The archeologists have determined the look of a quarter with monumental buildings, in front of an ancient theater, with a network of streets and a road separating the quarter from the port's waterside. They have also established the city's boundary in the north and discovered a mysterious structure built on a circular plan next to the remnants of an ancient theater that is currently under

conservation. All these structures were made from sun-dried mud bricks. Due to the local climate, fired bricks were used the most often in coastal areas during Roman times, as they were more resistant to moisture, the archeologists say.

The project combines a number of different research methods, including magnetic studies, which make it possible to determine building outlines, and electrical resistance tests, which in some cases can offer detailed plans of the foundations of homes and precise outlines of individual rooms, says Tomasz Herlich from the Department of Applied Sciences at the Polish Academy of Sciences' Institute of Archeology and Ethnology in Warsaw.

Sewage as an Energy Source



Researchers are working to develop a method to generate energy from sewage produced by sailboats and motorboats plying the Great Mazurian Lakes in northeastern Poland.

Sewage combined with plant biomass could be used in biogas generation plants, says Prof. Mirosław Krzemieniewski from the Environmental Protection Department of the University of Warmia and Mazuria in Olsztyn.

Statistics show that from 10,000 to 12,500 sailboats ply the Great Mazurian Lakes every year, with about 50,000 people on board. Half these boats are equipped with chemical toilets that deodorize, dissolve and dehydrate human waste. The chemicals used for this are strongly germicidal and the resulting mixture of feces and chemicals requires special treatment. Anaerobic biodegradation processes are the best option, experts say. Microorganisms in anaerobic sediment

are capable of decomposing toxic chemical compounds. In addition, as a result of fermentation, chemical toilets can provide biogas containing high-energy methane.

There are biogas generation plants fueled by corn silage in Poland. But generating energy from plant biomass alone is expensive, Krzemieniewski says. To reduce the cost, the silage could be mixed with animal feces or sewage from chemical toilets used on sailboats, he adds.

Fish for the Bay

Tasty fish species such as rainbow trout may soon replace small and inedible fish like three-spined sticklebacks in the Bay of Puck, northern Poland, under a project overseen by the Marine Station of the University of Gdańsk's Institute of Oceanography in the town of Hel. Under the Fish for the Bay campaign, batches of 30,000-50,000 rainbow trout are being let into the Bay of Puck.

In the past, the Bay of Puck was home to various valuable species of fish, both freshwater and saltwater varieties. But environmental pollution and intensive fishing caused the bay to be dominated by inedible fish varieties such as round goby and stickleback, the researchers say. These feed on the larvae and eggs of utility fish and compete for food with young fish of other species.

Research by the Hel Marine Station has shown that sticklebacks are the



favorite food of rainbow trout. This American species does not breed naturally in the Baltic, so its population can be easily controlled, the researchers say. Rainbow trout is highly valued by anglers, fishermen and gourmets, which should have a beneficial impact on the incomes of the local population.



Beware of Ticks

The incidence of tick-borne encephalitis (TBE) has grown by 400 percent in Europe over the past 30 years. In Poland, regional epidemiological stations are recording a growing incidence of the disease, at about 300-330 cases per year, with experts warning that this data may be underestimated. According to doctors, more than 30 percent of TBE cases end in long-term paresis, paralysis and neurological damage, and in a minority of patients—in death.

At the same time, there is no causal treatment for this dangerous disease; the only effective method of combating it are vaccinations, doctors say. Statistics show that in countries that use mass-scale vaccination against TBE, incidence has dropped substantially. In Austria, where almost 90 percent of the population is vaccinated, incidence has decreased from about 700 to 40-60 cases per year. In Poland, meanwhile, despite the Ministry of Health's recommendations, such prevention measures are used by less than 1 percent of the population.

Epidemiologists are trying to determine which regions of the country are especially abundant in the ticks that carry the virus (endemic regions). According to official epidemiological data, the majority of TBE cases in

Poland occur in a dozen or so counties, mainly in two provinces, Podlasie and Warmia-Mazuria. However, preliminary studies by the National Institute of Public Health show that the risk of contracting the disease has increased significantly in other regions as well.

In 2008, the institute's experts launched a project to make a precise map of TBE endemic regions. They are focusing on counties with a theoretically lower risk level in Pomerania, Kujawy-Pomerania, West Pomerania, Wielkopolska, Lower Silesia, and Malopolska provinces. They are working with the most widely used and most reliable method for estimating endemic regions, based on hand-picking ticks and checking how many carry the dangerous pathogens. This method has made it possible to determine that in Starogard Gdański county, for example, the tick infection rate is 12.2 percent.

Studies have shown the same incidence in endemic regions as those that until now were considered non-endemic. These preliminary tests have been confirmed using other methods, for example checking the number of TBE-infected goats—animals that are frequent carriers of the virus. In both cases, 1-8 percent of the goats were infected.

Compiled by Tadeusz Belerski

THE POLISH SCIENCE
VOICE