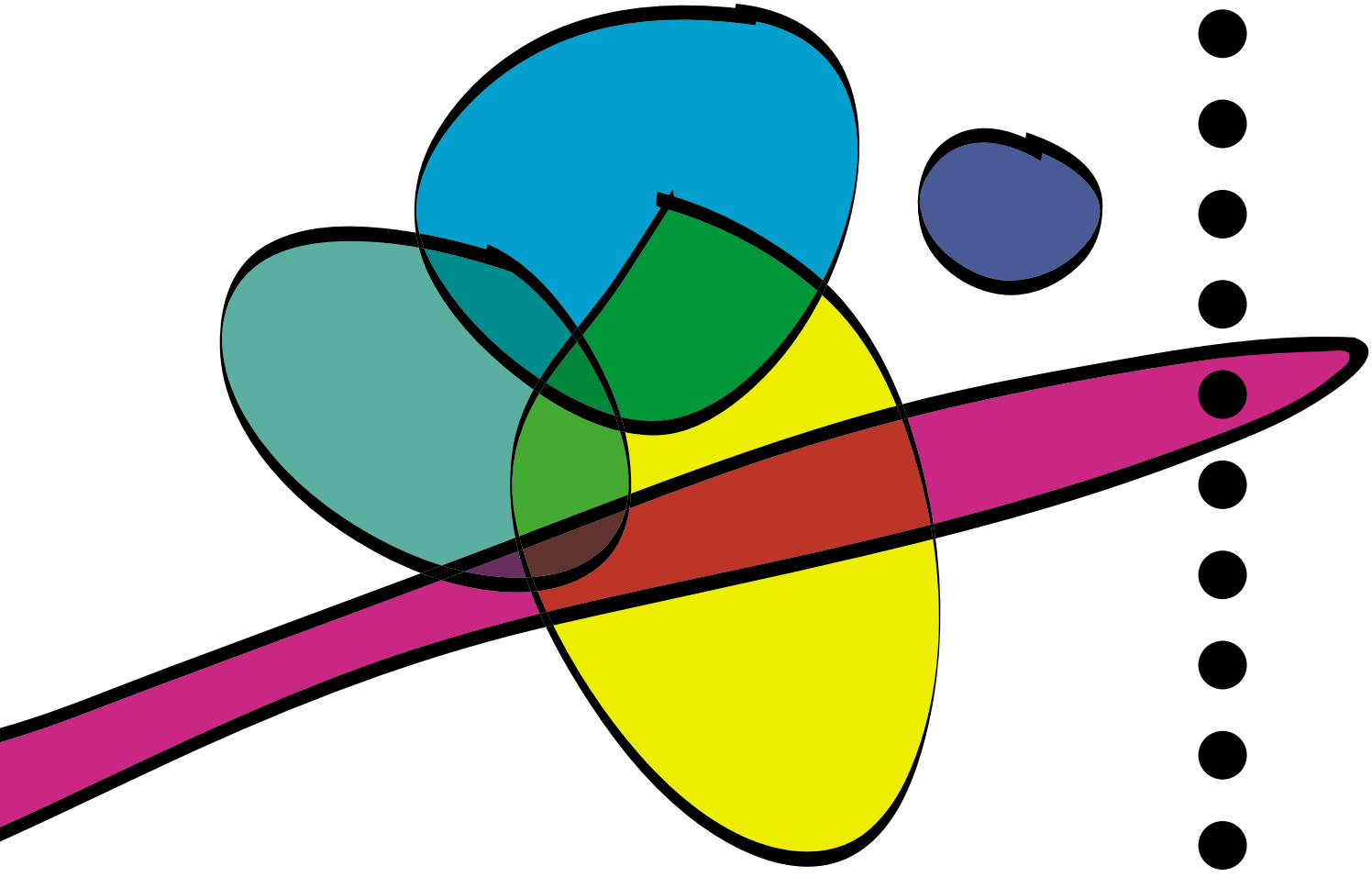
FAPESP

TECHNOLOGICAL INNOVATION



FAPESP Technological Innovation
The generation and application of knowledge

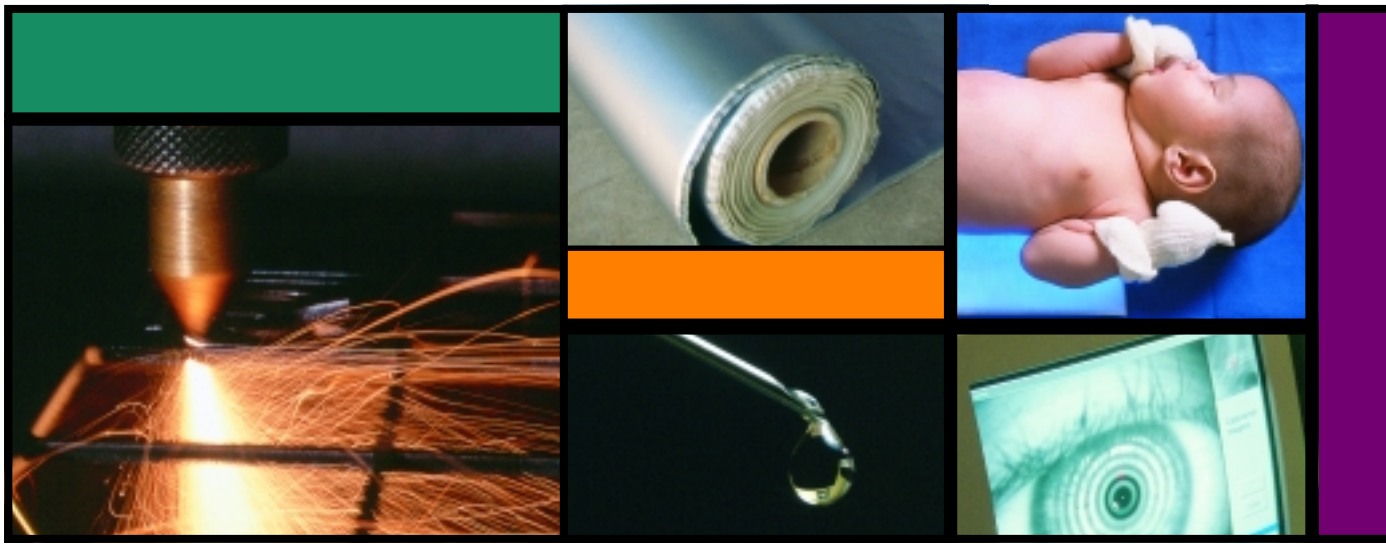
This publication contains information on twenty-four successful projects under the Small Business Innovation Research Program (PIPE) and Partnership for Technological Innovation Program (PITE) – two of the Technological Innovation programs supported by FAPESP. The State of São Paulo Research Foundation. Projects in these two programs have already generated 85 patent and licence requests in the areas of health, engineering, pharmacology, agronomy, genetics, ecology and other areas, both in Brazil and abroad. Optical systems, drills for dental treatment, fuel from sugarcane bagasse, robotized equipment for chemical analyses, growth hormone produced with the recombinant DNA technique, fuel cells, an optical fiber blanket to fight jaundice, and many others. These are projects that demonstrate the nation's capacity for the generation and application of knowledge, the fruit of significant joint state and federal government investment over the last decades in order to create a robust post-graduate system in the public universities and research institutes of the state of São Paulo.

FAPESP, one of the largest agencies for the support of scientific research in Brazil, is managed by research scientists. It offers grants and fellowships to support research projects through regular and special programs and programs aimed at Technological Innovation. In the latter category, the Foundation has eleven programs covering genomics, biodiversity, public policies, patents, Internet, molecular biology and research into the genetic diversity of viruses significant to public health care. The common goal is innovation.

Specifically targeted at the development of innovative technological products and processes, there are the PITE and the PIPE Programs along with the Sectorial Consortiums for Technological Research (ConSITec). Moreover, the foundation also has a special program for the support of intellectual property to guarantee the rights of researchers, institutions and businesses over the results of concluded projects.

Since its commencement in 1962, FAPESP's main criteria in the assessment of funding proposals are the project's merit and the qualification of the applicants. The assessment system adopted by the Foundation – peer review –, is one reason why the Brazilian scientific community and other research institutions –, including foreign ones, respect the Foundation's procedures. Any applications for grants or fellowships sent to FAPESP, in any of its programs, are reviewed by *ad hoc* assessors, specialists in the areas of each project. These scientists comprise a network of more that six thousand researchers active in the state of São Paulo, in other regions and abroad.

The Constitution of the state of São Paulo establishes that the main income of FAPESP must be equivalent to 1 per cent of the tax revenues of the state and transferred to the Foundation monthly. Added to the income from the institution's assets, in 2003 these resources allowed for an investment of US$ 120 million in scientific and technological research projects. Traditionally, 30 per cent of this total is invested in scholarship grants of six modalities, from Scientific Initiation to Post-Doctorate. In compliance with the bill that created it, the Foundation's administration costs must not exceed 5 per cent of the investment made in research.



Innovative products and processes are the focus of eleven special programs

A revolution in research support

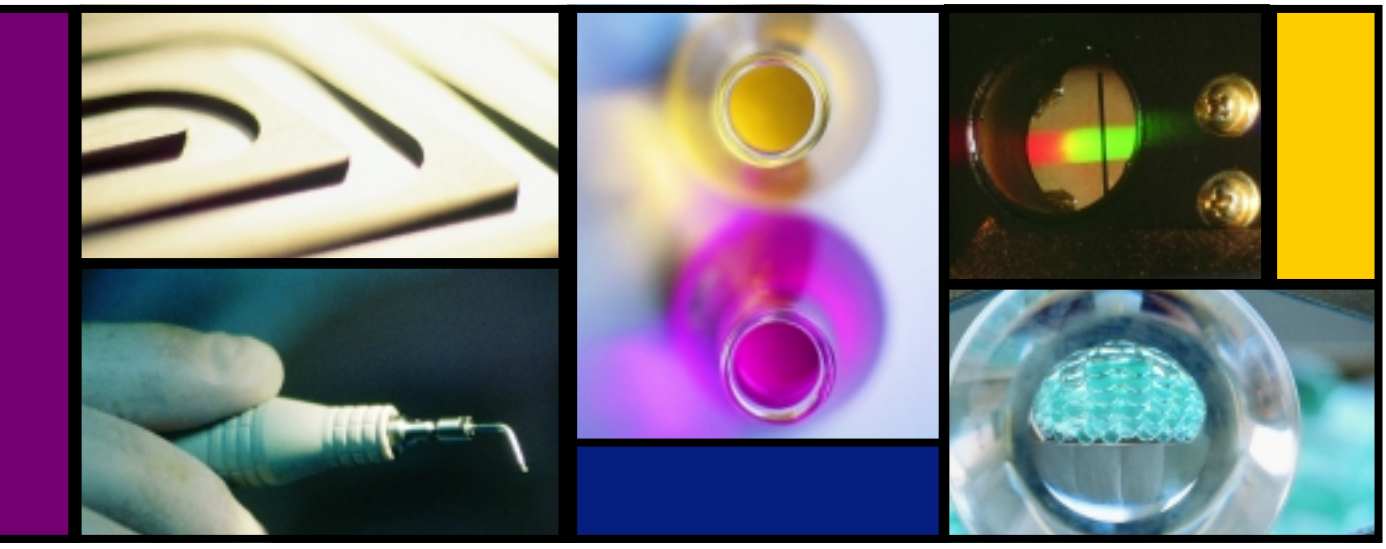
In the ten years of its existence, the eleven programs of FAPESP aiming at Technological Innovation have produced a revolution in the way scientific research in Brazil is financed, as well as yielding high quality results in highly competitive areas. Brazilian scientists whether or not associated with national or transnational businesses have produced original, sometimes entirely new research, capable of displacing cutting edge technologies produced in the great world centers, once they reach the market. Some examples of these results are an anti-hypertensive medicine obtained from the venom of the *Bothrops jararaca* snake; synthetic diamond drill bits for use in dentistry; a new chip design capable of increasing computer memory 250 times; nanocomposite catalisers with the potential of being used in processes for the production of hydrogen.

FAPESP's first initiative in the direct funding of technological innovation occurred at the end of 1994, when the institution decided to put into operation the idea of a research program aimed not just at knowledge generation, but also at its dissemination and application, and with an underlying concept which envisioned the transformation of this knowledge into wealth. In response to the wishes of society, FAPESP took on the challenge of adding to its mission of fostering scientific research, a commitment to the creation of economic development opportunities in a new way: jointly funding research projects with companies. The objective was to match the supply of the academic research sector with the demands of the private sector. The most significant innovation was the requirement that the partner company demonstrate a real interest in transferring the technology that the project was intended to produce. With shared risks and costs, this would also provide a guarantee that it would be possible to overcome the unequal relationship between the academic environment and business.

Investment in innovation

In 1995, the first program aimed at Technological Innovation currently running began operations. Conceived by the Scientific Board and approved by the Board of Trustees of the Foundation, the Partnership for Technological Innovation Program, PITE in its Portuguese acronym, started to accept proposals in that year. And, in nine years of activity, the program has approved 72 projects and invested US$ 27 million – 46 per cent contributed by the 55 partner companies.

Created in 1997, the Small Business Technological Research Program – PIPE in its Portuguese acronym, is essentially the same as the Small Business Innovation Research Program (SBIR), run by the National Science Foundation (NSF). In this second dimension of



FAPESP's support line for innovation, projects are developed in three phases in a small company, and investment from the company is not required but it must create innovations with a commercial value. In the first phase, the feasibility of the proposal must be appraised. In the second phase, a prototype of the intended innovation must be developed. For the third phase, there is no funding: the Foundation helps the company to draw up a sound business plan through agreements FAPESP has with the Financier of Studies and Projects –Finep, and the state of São Paulo's Support Service for Micro and Small Businesses, Sebrae-SP in the Portuguese acronym, in addition to other venture capital institutions. One of the assumptions is that micro and small businesses are important vectors of technological development; in other words, they can generate technologies that can reach production lines or be handed over to larger companies.

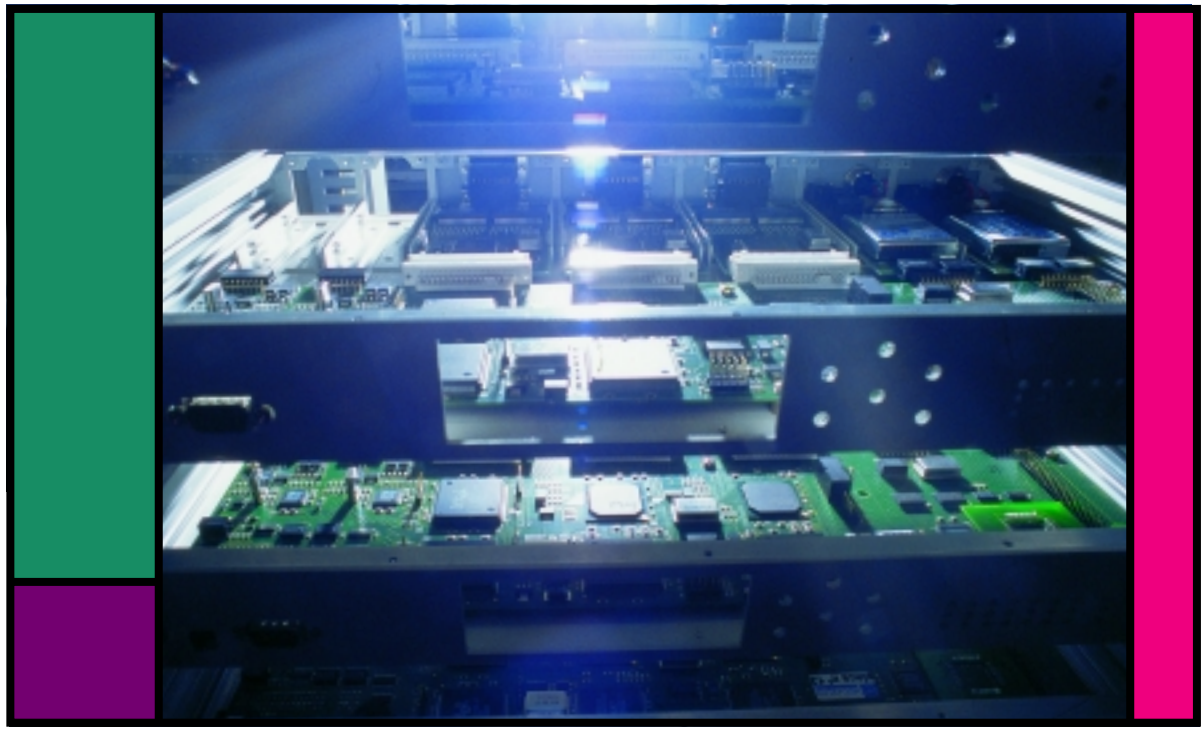
PIPE also seeks to stimulate graduate and post-graduate students to start up companies as a strategy of adding knowledge produced in the academic environment to marketable goods, by developing research aimed at innovation.

Advances and ever greater efforts

In its first year of activity, PIPE received 82 proposals and 32 of them obtained funding. More than US$ 16,7 million have already been invested in the 286 projects approved until 2004. Of these projects, 146 are in the second phase or are securing capital to market their results in Brazil or even abroad. An important evolution of the program are the agreements with Support Service for Micro and Small Businesses and with the Endeavor Enterprising Institute (Instituto Empreendedor Endeavor), in order to improve the companies' managerial performance. In the third stage, FAPESP remains present, not financially but institutionally, through the partnerships that the Foundation has, so that small companies may be able to compete for venture capital to finance scale production of their innovations.

The confirmation that Research and Development investment by companies does indeed bring important socio-economic returns has opened perspectives for the formation of groups of companies within the same industry in partnership with state of São Paulo's teaching and research institutions. The idea is to solve common technological problems. This perception has led FAPESP to offer a third form of university-company cooperation: the Sectorial Consortium for Technological Innovation Program, ConSITec in ints Portuguese acronym.

There has been another almost unavoidable consequence. Jointly responsible for the generation of a considerable amount of innovations – in fact, inventions of proven originality – FAPESP decided to organize the Program of Support for Intellectual Property – PAPI in the Portuguese acronym – that works under the Nucleus of Technology Patenting and Licensing, Nuplitec. It assists the researcher in the protection of intellectual property over the project results. Since May 2000, 85 funding requests have been approved, and in 2003, US$ 194 thousand were invested in these patents and licences.



PHOTOGRAPH BY MIGUEL BOYAYAN

Multiplexers transmit combined signals through one single optical fiber

Frontline Optical Systems

AsGa, a Brazilian manufacturer of equipment for telecommunication systems with optical fiber transmission, is one of the greatest business success stories in Brazil's high-tech industry. The company was founded in 1989 by a group of former professors from the State University of Campinas (Unicamp) in the state of São Paulo, with the aim of establishing the production of optoelectronic components in Brazil. By 2002 AsGa was achieving revenues in excess of US$ 10 million – three years earlier, revenues barely reached US$ 5,7 million. The company is the main supplier of optical modems to the Brazilian telecoms industry and its products are sold throughout Brazil and exported to other countries. It has branches in Argentina and Mexico and several representatives abroad, including in Portugal, Chile and Malaysia. Market success is due to the company's investment in Research and Development. AsGa spends about 15 per cent of its revenues on technological projects within its facilities which are located in the city of Valinhos, 118 kilometers from São Paulo.

The company's flagship is its line of multiplexers and optical modems which are at the cutting edge of telecommunications. These devices are used in telephone networks, linking large companies with telephone switching centers and mobile phone centers with their switching centers. The multiplexers transmit various signals (voice calls or data processing) through one channel, bringing them together and combining them. They also allow a single optical fiber to carry 1,890 times more lines or voice channels than copper wire.

AsGa was the first Brazilian company to produce multiplexers and today has 70 per cent of the Brazilian market. In 1998, the company took a giant technological leap forward by creating a new line of faster and more sophisticated multiplexers, suited to working in the 155 megabits per second (Mb/s) bandwidth, against the 34 Mb/s of the previous set, of the MMO 16E1 modem. "AsGa was the first of the large telecoms equipment makers that dared to get into this category of devices", said company president and MIT Ph.D, José Ellis Ripper Filho. To develop this equipment and the 16E1 modem the company received funding from FAPESP through the Small Business Innovation Research Program (PIPE in the Portuguese acronym).

PHOTOGRAPH BY PETROBRAS

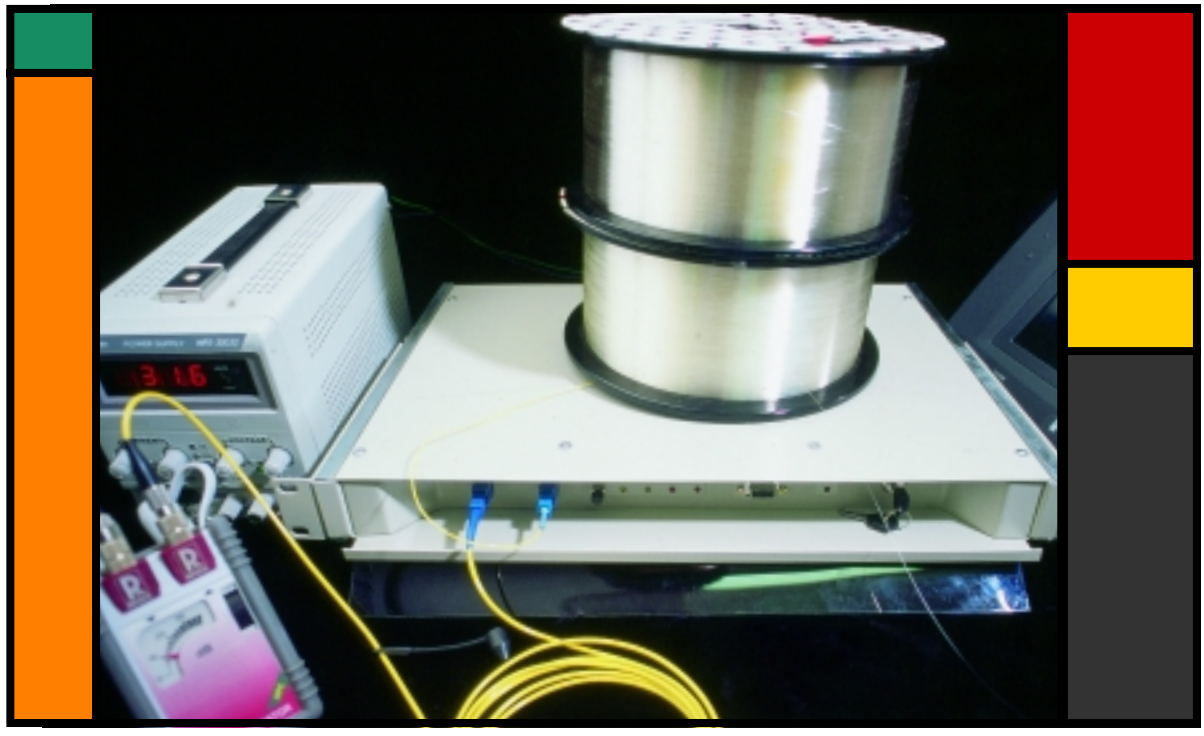
Optimization in real time. Integrated process raises profits in oil refining

Savings on oil products

The University of São Paulo (USP) and Petrobras signed a partnership at the end of the last decade to develop a software program that is generating a considerable increase in the profitability of the company's oil refining operations. Several systems are optimizing the production of the company's eleven oil refineries and a shale-processing factory, a rock from which oil is extracted. "The software carries out the integrated optimization of the whole process from manufacture control to longer term corporate decisions", says engineer Lincoln Moro, senior consultant of Petrobras's Refining Optimization Management. According to Moro, the program helped update Petrobras's Advanced Control System (SICON) and also helped consolidate the technology for real time optimization, in use or in the process of implementation in all the company's units. These technologies are providing US$ 0.25 savings per processed barrel (oil or products). As Petrobras processes around 1.8 million barrels a day, the total savings reach US$ 450 thousand.

At USP, the project was coordinated by professor Cláudio Augusto Oller do Nascimento, from the Chemical Engineering Department of the Polytechnic school. He and his team were responsible for the software matrixes, the so-called algorithms (calculations and functions), which, on many occasions, were developed for masters and doctoral thesis by the Petrobras employees themselves. The practical application and the development of the software is carried out in company's refineries. Prior to this program, there was no system capable of optimizing the refineries in an integrated form.

Although there are similar systems to SICON in other oil companies around the world, control and optimization systems such as the one developed by USP and Petrobras are a novelty in the world due to the advanced level of technology achieved. The industrial implementation of each of these programs usually costs around US$ 600 thousand. When this figure is multiplied by 30, the number of units where SICON is installed – and each refinery might have more than one –, a sum of US$ 18 million may be arrived at. This amount is a lot less than was spent on the creation of the optimization software. Petrobras has invested around US$ 191 thousand and FAPESP, which funded the research through the Partnership for Technological Innovation Program (PITE), contributed US$ 175 thousand.



PHOTOGRAPH BY MIGUEL BOYAYAN

Brighter light on telecommunication

Equipment for telecommunications networks

One of the most advanced fields of technological research is the area in which a Brazilian company called OptoLink operates, the production of equipment and components for optical fiber communications. Located in Campinas, in the state of São Paulo, and started by former researchers of the Research and Development Center (CPqD in the Portuguese acronym) of the former state telecom monopoly Telebrás, OptoLink has developed and produced optical fiber cable couplers used in amplifiers for the transmission and distribution of optical signals in telephone switchboards, cable TV networks and the Internet.

The function of the amplifier is to boost the light of the signals emitted by telephone switching centers or cable TV that work with optical fibers, as the signals lose their intensity in the journey between one point and another. The couplers are used in the amplifiers and their job is to join or separate the signals (there can be tens of calls at the same time) transmitted by optical fiber.

Established in 1998 at the incubator of the Company for the Development of Technological Excellence (Ciatec) in Campinas (*Companhia de Desenvolvimento do Pólo de Alta Tecnologia de Campinas*) by 2001 the company had already made prototypes of the products and was preparing to partner with the multinational company Solectron, aiming for mass production. However, the telecoms components market plunged and Solectron decided to cancel the project at the end of 2003. Despite these troubles, OptoLink has grown, and left the incubator and today has a space in the Post-Incubation Center for Technology Companies, next to the State University of Campinas (Unicamp).

According to the main company manager, Ildefonso Félix de Faria Júnior, in 2003 sales exceeded US$ 330 thousand, twice as much as last year. Of this amount, he points out that about 10 per cent is being invested in new product development – and today they are reaping the rewards – among which is a process for the metallization of optical fibers to be used in encapsulation of optoelectronic components, such as lasers and photodetectors. In instrumentation, OptoLink is developing a project of light sources to integrate monitoring systems for optical fiber networks.

PHOTOGRAPH BY MIGUEL BOYAYAN

Reference materials calibrate equipment for export

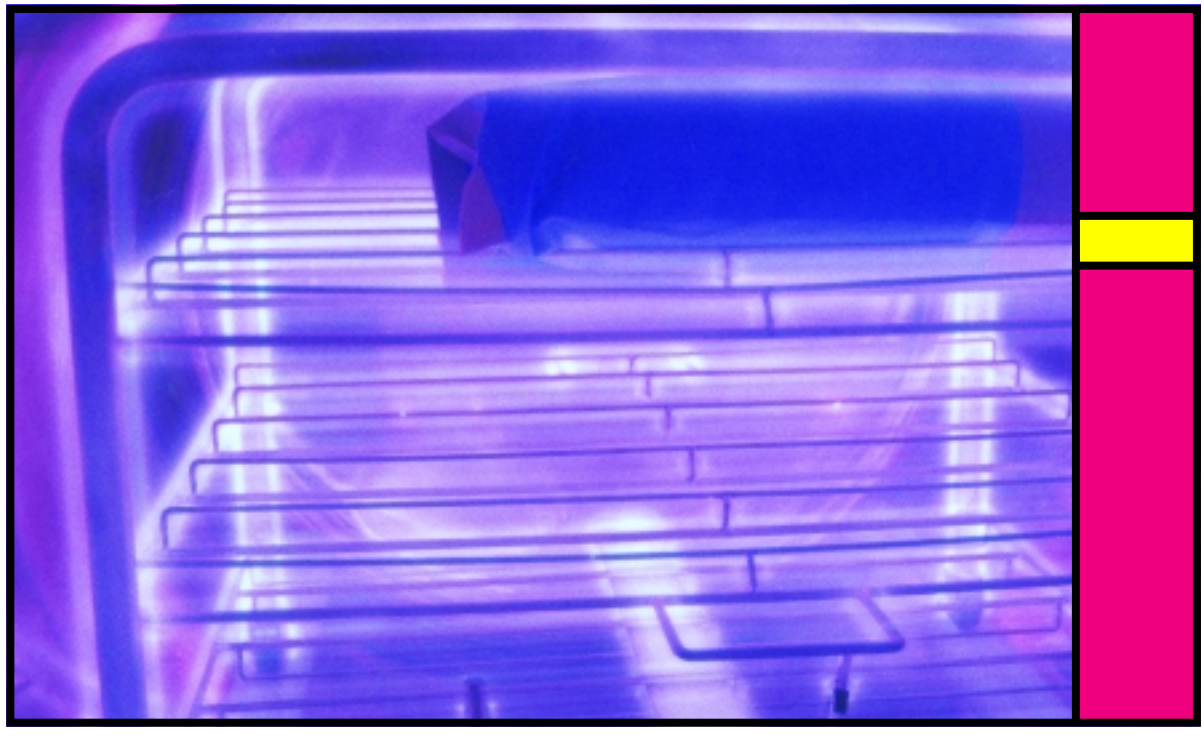
Laboratory for the chemical industry

Installed in the Technology Incubator at the *Universidade do Vale do Paraíba* (Univap, in São José dos Campos, in the state of São Paulo), Quimlab produces certified reference materials which are used in the chemical industry for calibration and equipment control. Funded by FAPESP, the company set up a chemical metrology laboratory in which conforms to international standards. It must be emphasized, that in a global scenario, the metrology industry is strategic for Brazilian exports due to the need for technical specification of products in compliance with the norms which exist in the USA and Japan.

According to Nilton Pereira Alves, Quimlab's owner, the laboratory is up and ready, and now is awaiting the certification of the National Institute of Metrology, Standardization and Industrial Quality – Inmetro. The green light has yet to be given since, according to Pereira Alves, the institute does not have the proper norms to certify Quimlab as a producer of reference material. The expectation is that, using this pioneering center as a springboard, research will be developed benefiting Inmetro and other agencies and thus create the basis of chemical metrology in Brazil.

Quimlab, founded in 1997, elaborates and produces traceable standard solutions, substances for industrial use to measure the so-called chemical values. For example, the percentage of lead or iron found in a metal alloy or the pH value of a certain item, thus indicating if it is acid, neutral or basic. The devices that carry out such analyses are adjusted and calibrated in comparison with the standard solutions produced by Quimlab. The company sells to, among others, the pharmaceutical, metal and oil industries. The production in Brazil of certified pH standards – until now the product has been imported – helps the user companies save money since the national product is cheaper than the imported ones and delivery is immediate.

Jointly with universities, Quimlab is carrying out investigations into other lines of research, and the company also undertakes chemical analyses and consulting jobs for the development of specific reference material used by certain industries such as, for example, the makers of synthetic fibers.



PHOTOGRAPH BY STERLILY

Ultra-violet radiation inside of the sterilization chamber

Quick and efficient sterilizer

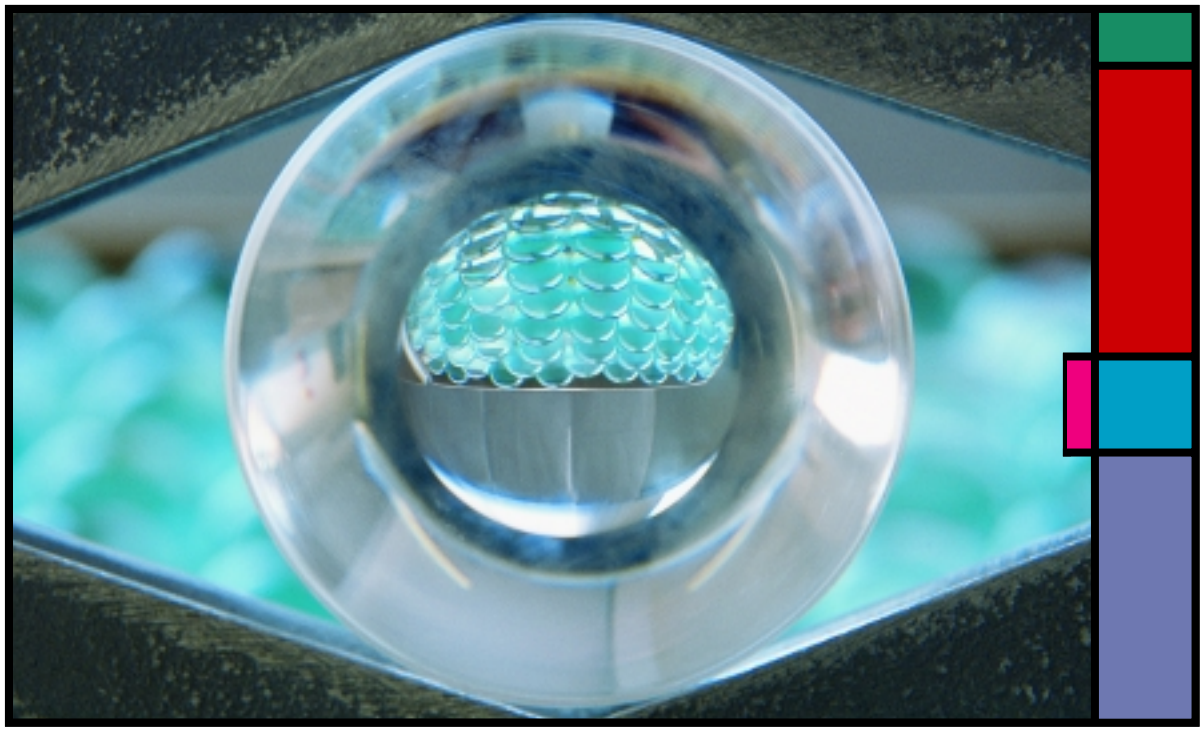
A plasma "fueled" sterilizer has been developed by Sterlily, a company incubated in the Company for the Development of Technological Excellence (Ciatec) in Campinas in the state of São Paulo. Dubbed Esteriliza 1000, the equipment eliminates fungi and bacteria and its target markets are hospitals, the pharmaceutical, veterinary and food industries, among others.

Considered to be the fourth state of matter, plasma is produced by applying an intense electrical field to certain gases. The action of this field supplies energy to ions and electrons which collide with the atoms and the molecules. This situation excites the molecules, spawning free radicals and ultraviolet radiation. The result is a joint action against membranes, enzymes and nucleic acids that make up the cells of microorganisms, destroying their vital functions. The novelty in this kind of equipment is the chamber in which the sterilization process is carried out at low temperature and in dry conditions.

The first prototype of the device was used in the sterilization of over 12 thousand plastic recipients for the cultivation of cloned plants, as well as disposable syringes and jars for clinical analysis.
The sterilization cycle is considered to be quick – around one and a half hours for plastic materials.

The equipment comprises a stainless steel cylinder within which an environment with reduced pressure is created in order to generate vacuum. Drawers with cavities receive the material which is wrapped in polypropylene packing, developed in Brazil for this purpose. It allows the gases to pass through, but blocks the microorganisms. Immediately after that, nitrogen peroxide gas is released into the interior of the chamber, where a high frequency electrical field is applied, thus creating ultraviolet radiation. This type of sterilization has specific features, such as the low temperature, ranging from 35° C to 40° C, making it appropriate for application with several materials. According to Tadashi Shiosawa, one of directors of Sterlily, the Esteriliza 1000 – the price of which ranges from US$ 133 thousand to US$ 167 thousand – is awaiting registration by the Health Ministry before starting to be sold.

PHOTOGRAPH BY EDUARDO CESAR



Focus on surgical applications and precision optical devices

Novel technology in special lenses

Special Lenses that guarantee high quality images, without the minor distortions of conventional lenses are being produced by Optovac, a company located in Osasco, in Metropolitan São Paulo. Called non-spherical or aspherical lenses, they are able to retain focus more efficiently and have several applications, including medical lenses used in many surgeries, and optical microscopes in laboratories and cameras.

The production of aspherical lenses, the market for which is highly promising, was a great technological challenge for Optovac. Started just over two years ago, the development of the project resulted in injectable plastic lenses – polycarbonate, polystyrene or acrylic – which allowed the company to halve the cost. According to company director and coordinator of the project, Sérgio Antônio de Almeida Nobre, it is a novel technology in Brazil and unique in the southern hemisphere.

The electronics and telecoms industries have increasingly been demanding aspherical lenses. They are used, for instance, in camcorders, light sensors and optical couplers (optical fiber connectors).

Optovac is presently not focused on these highly competitive sectors. The idea is to win market share in the educational and technical areas and in the general market, with optical kits for physics classes, stereo microscopes (binoculars for teaching, industrial use and research in micro-assembly in electrical areas), auto headlight lenses with high performance lighting and components for medical tools companies, home appliances and electric equipment which, in some cases, can reach the market at half the price of imported goods. Sergio Nobre's intention is to also gear up the company to export, mainly products aimed at the area of education.

Optovac is certified by the Brazilian Army Aviation for the development and maintenance of optical equipment, such as night vision goggles, currently imported.

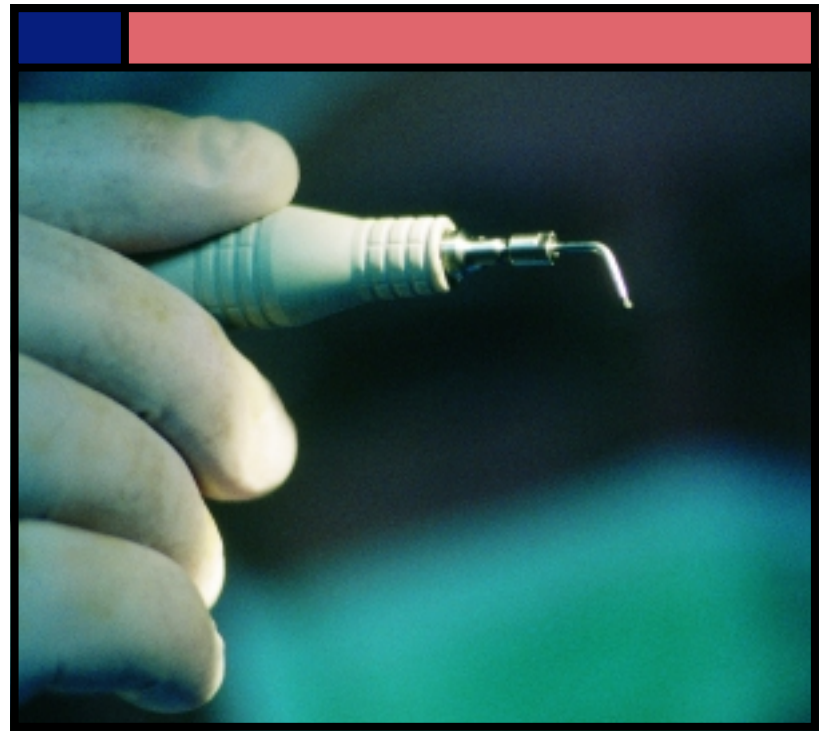
New drills for dental treatment

A team of researchers from Clorovale Diamantes, a high-tech company located in São José dos Campos, 100 kilometers from São Paulo, has developed a new line of dental drills coated with a synthetic diamond tip which has brought great advantages for dentists and patients. The company has attained an innovative and sophisticated production process and is the first company in Latin America to produce pure synthetic diamonds, with no metal addition.

A survey among a group of 500 dentists has shown that in more than 70 per cent of treatments carried out with the equipment, the patient required no anesthetic as the intervention is painless. This happens because the drill, which works in ultra-sound devices, reaches the dental cavity through vibration, without crushing the dentine, the region of the tooth in which there are extremely small canals responsible for the sensitivity of the tooth. The treatment with these drills is very precise and minimally invasive, avoiding wear and unnecessary trauma to the tooth. Moreover, unlike traditional drills, which work in high-rotation devices, the ultra-sound drills do not make that high-pitched noise that frightens so many people.

Another Clorovale innovation is the conventional rotation drill coated with CVD diamond, a material obtained through Chemical Vapor Deposition. It is exactly the same diamond as used to coat the ultra-sound drills. Clorovale was the pioneering company in Latin America in the development of CVD diamond which has the characteristics of natural diamond and can be obtained in any size and form, and is much purer than the artificial diamonds known by the acronym HPHT (High Pressure, High Temperature). This conventional technology uses diamond powder and nickel solder on a steel rod, whereas the CVD diamond grows on the rod itself, covering it until the desired thickness is attained.

The drills were launched on the market in the beginning of 2003 and, according to Clorovale, have been very well received by dentists. The physicist Vladimir Trava Airoldi, one of founders of the company, reckons that gross sales income will reach US$ 9,4 million in the first two years. Each ultra-sound diamond coated drill costs about US$ 67, twenty times more than the conventional drills. This, however, should not be a hindrance to the commercial success of the product, as Airoldi points out, they last twenty to thirty times longer.
The drills are sold in twelve different models for various areas of dentistry. Both Clorovale drills have been patented in Brazil, United States, Canada, Japan and Europe.
The company intends to sell to customers in the five continents. The goal is to reach 15 per cent of the 300 thousand dental professionals in Latin America and 3 per cent of the 2.5 million dentists of the rest of the world in five years. To win over the American market, the researchers are filing for registration with the Food and Drug Administration (FDA), agency that regulates food and medicine.

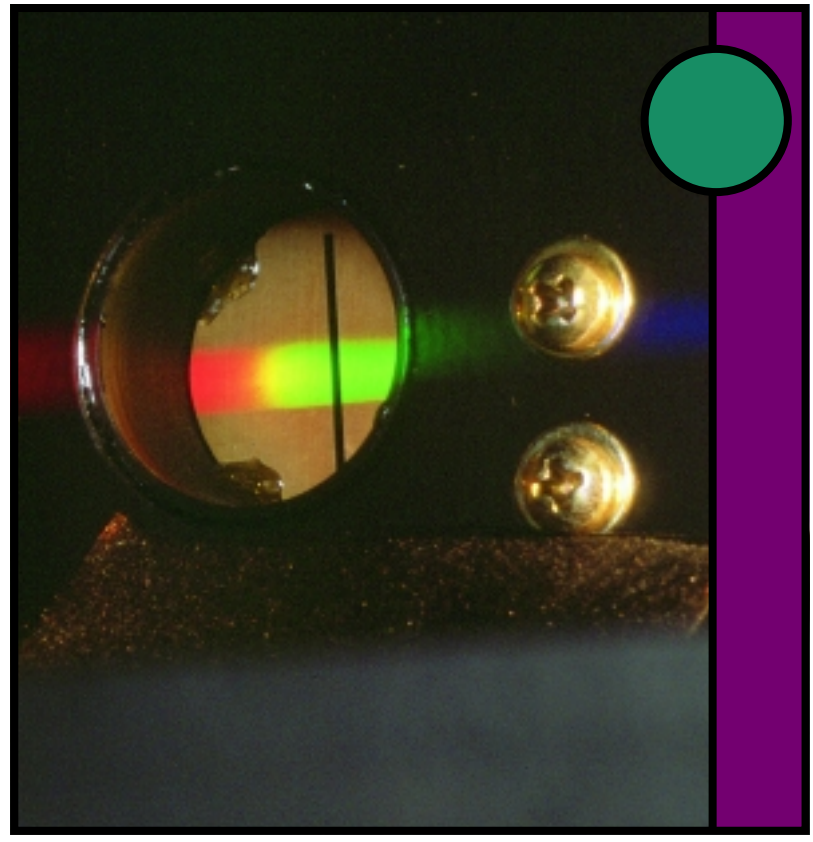


PHOTOGRAPH BY MIGUEL BOYAYAN

No pain, no anesthesia, no trauma, no noise

Automated and robotized chemical analysis

Laboratory technicians specialized in the analysis of food and other substances, won a strong ally at the end of 90's with a technological innovation developed by Femto Indústria e Comércio de Instrumentos, whose headquarters are in São Paulo. The company created a Spectrophotometric Workstation which is a totally automated and robotized chemical analyzer. Widely used by industries, research institutes, environment protection agencies and companies from various sectors, the apparatus is capable of quantifying, for instance, the presence of chloride, nitrate, iron and silica in water, or detect cyanide, sulfate, phosphate and ammonia in domestic or industrial effluents. It also makes it possible to measure the level of calcium and phosphorus in animal feed, and magnesium and phosphorus in plants. All of this in a fraction of the time taken by the traditional methods.



PHOTOGRAPH BY EDUARDO CESAR

Station provides more quality and is faster and cheaper

The project was funded by FAPESP under the Small Business Innovation Research Program (PIPE in the Portuguese acronym). According to physicist Lídio Takayama, one of Femto's partners, the use of automated and robotized workstations brings several benefits to the laboratories, such as the reduction of operational and management costs and also enables the laboratories to attain greater speed in the analysis processing. Furthermore, the use of the apparatus allows almost real time quality control, error reduction, increased safety, less wastage of chemical products and improved communication and services. Laboratory analysis with manual spectrophotometers is still widespread in Brazil, but automated pieces of equipment are gaining ever more ground, due to the support that is given to laboratories that handle great amounts of analyses.

Created in 1989, Femto is proud of its success story. It started its activities with the development and manufacture of visible light and ultraviolet spectrophotometers and is presently the only Latin American company to produce near infrared spectrophotometers using its own technology. Today, an even more advanced piece of equipment is in its completion phase, a fluorescence spectrophotometer with a continuous scanning double monochromator, an obligatory tool in Brazil to analyze surface water and water used in hemodialysis. Another FAPESP supported project is the development of an atomic absorption spectrophotometer with electrothermal atomizers, used to analyze soil, plants and foodstuffs. The device should be ready in 2006. With its diversified range of products Femto, which grosses US$ 670 thousand a year, intends to grab 30 per cent of the Brazilian market and 1 per cent of the world market over the next years. "We are preparing our export line which should be ready in 2005", says Lídio Takayama.

PHOTOGRAPH BY MIGUEL BOYAYAN

Fuel cell will supply energy to the largest city in Latin America

Clean and safe energy

São Paulo is getting ready to join a select club – that of cities in the world that use the fuel cell, an extremely sophisticated technological innovation. "The heart" of this equipment which produces electric energy from hydrogen, the cell was produced by Electrocell, a São Paulo company that has invested about five years in its development. Based at the Incubator Center of Technology Companies (Cietec) which is located in the building of The Institute of Nuclear Energy and Research (Ipen), on the University of São Paulo campus, the company has had wide technological and scientific support from the institute in the development of the cell's electrodes and catalysts.

The equipment is about to be delivered to AES Eletropaulo, the electricity utility that serves 24 municipalities in the Metropolitan Region of São Paulo (including the city of São Paulo). The fuel cell is a set of electrode modules and exchange membranes capable of producing 30 kilowatts (kW) of energy, enough to power two to three floors of a building or 40 small houses. The cell works with hydrogen stored in cylinders, but it is also capable of extracting this fuel from natural gas and ethanol (the alcohol used in Brazilian cars).

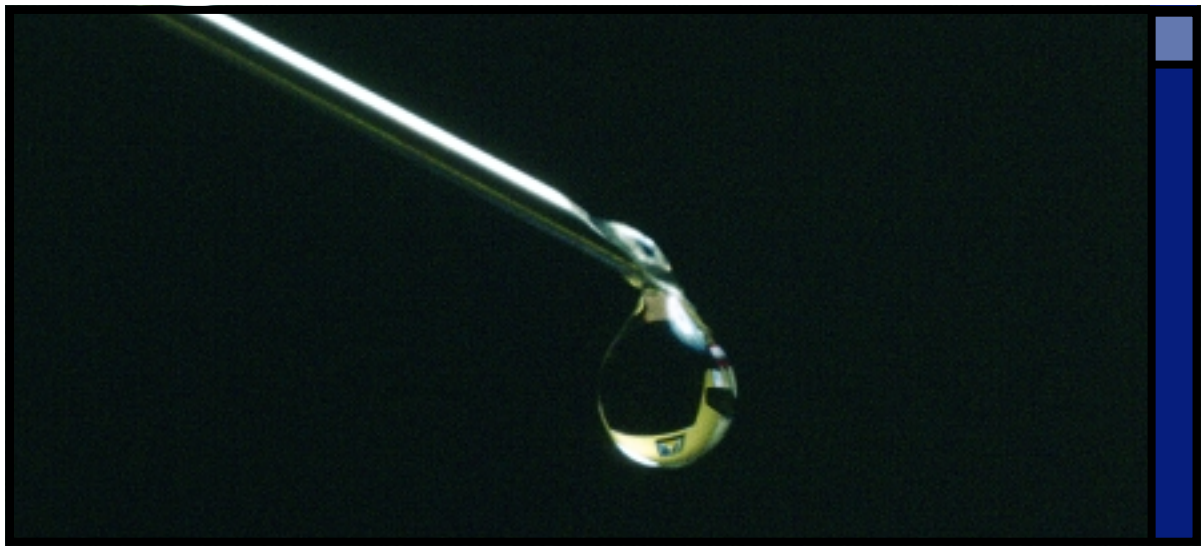
With the technological advances of the last 15 years, these cells – one of the spin-offs from the American space program – have become cheaper and have been adapted to more routine situations. American, Canadian and German companies have been producing them, made to order, for about five years.

The fuel cells work as a battery, transforming chemical energy into electrical energy, breaking down the hydrogen molecules that react with the oxygen in the air. In their stationary form they are similar to, and do the job of a generator, but they are smaller and work more silently than ordinary generators. Furthermore, they emit no pollutants.

As soon as it receives the equipment, Eletropaulo intends to install it in a building, where it will simulate the substitution of a fail-safe, the first step prior to testing it in other functions. The utility has invested US$ 570 thousand in the manufacture of the cell, money that came from the Energy Sectorial Fund, controlled by the Ministry of Science and Technology.

The first prototypes were developed with funds from FAPESP, in a project "that made the company take off", according to the electronics engineer Gilberto Janólio, one of the partners of the company. In these projects, 90 per cent of the material used was developed in Brazil. The only imported product is the Proton Exchange Membrane (PEM) characteristic of this type of cell.

PHOTOGRAPH BY EDUARDO CESAR



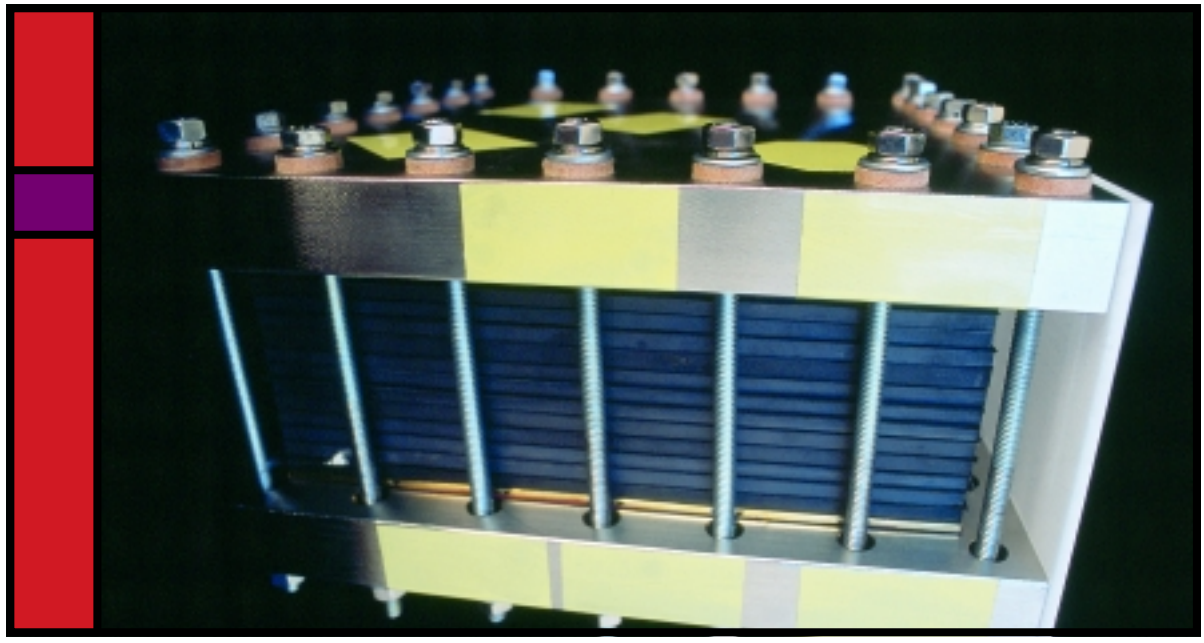
National production widens access to multiple-use medicine

Hormogen synthesizes the hgH

Brazil imports around 1 million doses of the Human Growth Hormone or more simply – hgH – every year. The estimated expenditure reaches US$ 15 million. Thanks to the effort of a small biotechnology company from the state of São Paulo – Hormogen – the country will no longer be an importer and will start to export this medicine. After years of research, the company has been able to develop in its laboratory the medicine which is chiefly prescribed for the treatment for children with growth deficit or dwarfism. Presently, only six countries – Sweden, Denmark, Switzerland, Israel, the United States and South Korea – have mastered manufacturing technology for this drug which can also be given to adults with hormonal deficiency, patients who have been through a renal transplant, girls with Turner syndrome – which causes short stature and sterility – or HIV positive patients who have lost muscle mass or are gravely debilitated.

Hormogen is not the only Brazilian company to have been able to synthesize the hgH. The production process of the hormone has already been mastered by Genosys Biotecnológica, another company supported by FAPESP, which promises to bring the product to market sometime in 2004. In both cases, the technique employed was the recombinant DNA. Hormogen's success led a large Brazilian Pharmaceutical company – Biolab-Sanus – to take an interest in the company and eventually take it over. In February 2002, the laboratory bought 75 per cent of Hormogen shares and it is responsible for marketing the product. For the controlling stake of the company, Biolab-Sanus paid the symbolic amount of US$100 thousand dollars. The remaining 25 per cent of the shares remain with the three researchers who founded Hormogen, and they are still responsible technically and scientifically for the product.

In order to carry out the necessary technological development and arrive at the pilot production, attracting potential investors, Hormogen received funds of US$ 115 thousand from FAPESP between 1998 and 2001. The money was invested mainly in reagents and equipment, such as the bioreactor where the bacteria that secrete the hgH multiply. According to chemist Paolo Bartolini, one of the founders of Hormogen and head of the Center of Molecular Biology of The Institute of Nuclear Energy and Research (IPEN), the medicine has gone through biological laboratory tests (using dwarf mice) and also through two modalities of physical-chemical and toxicological tests (using dogs and mice) and also immunologic tests, to prove the identity, potency and degree of purity, not to mention the safety of the drug. Production of the hormone should start in February of the next year (2005) in a Biolab-Sanus factory in Minas Gerais. Initially the laboratory intends to capture 10 per cent of the Brazilian market with the medicine which will be 20 per cent cheaper than imported ones.



PHOTOGRAPH BY MIGUEL BOYAYAN

The first Brazilian fuel cell. Concept was developed in the 19th century

Company creates fuel cell

Billions of dollars are spent every year by academic institutions and private laboratories around the world in search of improvements to fuel cells, a system that produces electric energy silently and without harming the environment. In Brazil, the first equipment of this kind was developed in 2001 by chemist Antonio César Ferreira, the owner of Unitech. The discovery was the crowning achievement of a dedicated and tireless scientist, who lived for nine years in the United States, where he took his post-doctorate and worked as a researcher in the Texas Agricultural and Mechanical University and at MER, a company located in Arizona. When he returned to Brazil, in the mid-90's, he set up his own laboratory to develop the catalysts, which are considered the heart of the fuel cell. The equipment Ferreira developed is the size of a small refrigerator, is fueled by hydrogen and can produce 1.5 kilowatt of electricity.

The cell can be explained as a sandwich of electrodes, catalysts and an electrolyte. It can receive pure hydrogen or obtain it from natural gas, gasoline, methanol (wood or cereal alcohol) or from ethanol (alcohol from sugarcane, used in Brazilian cars). Currently, extracting hydrogen from water is still an expensive option, as the electrolysis process that separates the hydrogen and the oxygen atoms needs electrical energy.

The working principle of fuel cells is based on the electrochemical reaction of the oxidation of the fuel. To assemble the first prototypes, Ferreira had to develop the bipolar catalyst plates, which are essential parts in the assembly of fuel cells. It is in the catalyst that the hydrogen (H2) molecules break down. The protons spawned from this reaction pass through the membrane to the anode (negative) side of the cell to make water. Meanwhile the electrons which originate from the breakdown of H2 circulate through the plate generating electricity.

The fuel cell produced by Unitech is part of a three-year program, with funds of US$ 1,7 million, that Companhia Energética de Minas Gerais (Energy Company of the State of Minas Gerais – Cemig) has spent on several projects for the development of this technology. Although it is a system that still needs improvement, the working concept of the fuel cell goes back to the 19th century. They were developed by the Welshman William Robert Grove, considered to be the father of the technology, in 1835. At the end of the 90's, the first fuel cells started to be sold in the United States, Canada and Japan. Presently, there are several prototypes capable of supplying electricity between 10 watts and 11 megawatts to serve the portable equipment of small towns.

PHOTOGRAPH BY MIGUEL BOYAYAN

Equipment diagnoses lesions with no need for biopsies

Greater precision in the detection of skin cancer

The diagnosis of skin cancer – the occurrence of which has been increasing in Brazil – can be done earlier and with greater precision thanks to a technology developed by Atonus Engenharia de Sistemas, a company from São José dos Campos, in the state of São Paulo. Founded in 1995 to operate mainly in the area of computational vision, creating systems with image capturing and analysis components, the company created a computational system comprising a special camera – the video episcope – which uses optical fiber lighting, software, and a remote database on the Internet.

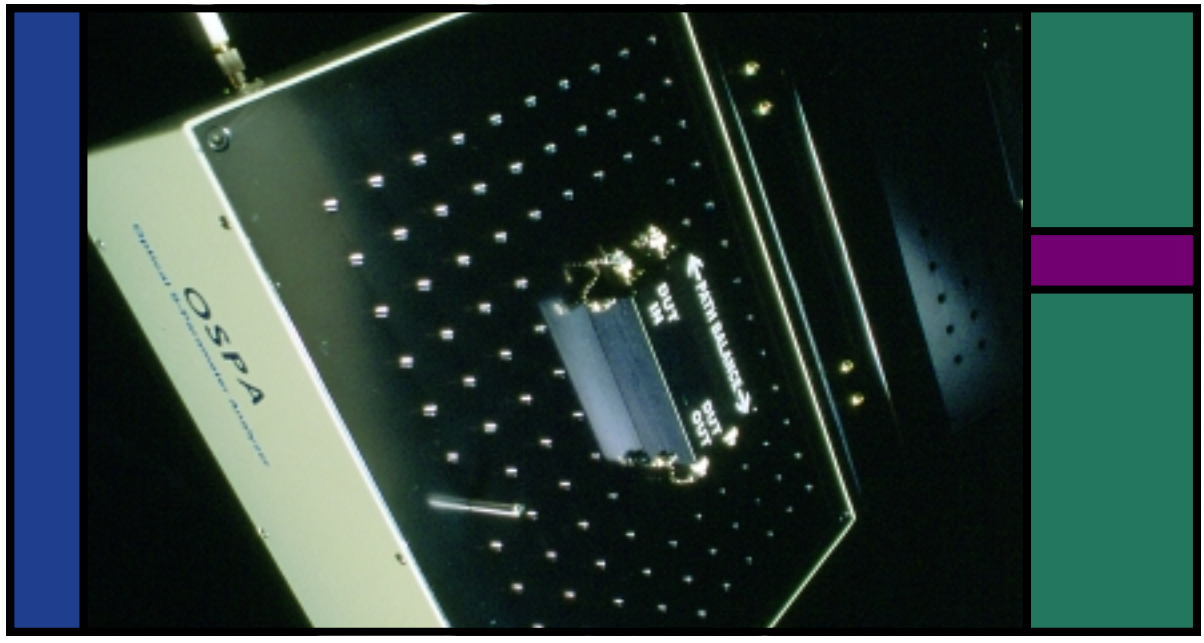
According to electrical engineer Antonio Francisco Junior, partner-director of Atonus, in at least 40 per cent of the cases, the clinical examination precisely evaluates whether a lesion is malignant or not. The digital video episcope (DVE) helps the specialist to reach a diagnosis, also reducing the number of biopsies, mainly in cases where regular medical check-ups are necessary.

The system's video episcope films the lesion and sends the color image to a computer, where a capturing board digitalizes the image. The software then analyzes the skin lesion morphologically (based on dermatoscopy 101), to appraise its asymmetry, the irregularity of the border and diameter. The data is stored after going through a seven point diagnostic checklist, including itching and irregular borders. Details observed by the physician, such as color detection and different structures are inserted manually in the program.

The evaluation of all these parameters produces a sort of pre-established dermatologic score, based on which the program determines whether the lesion is benign, malignant or in the gray zone. If a second opinion is wanted, the doctor can send the digitalized images through the Internet.

The DVE system is sold by the company in a set or separately. The complete system costs around US$ 9 thousand dollars, almost half the price of international competitors.

Atonus has also created a medical debate forum on the Internet which will enable the creation of a database about skin cancer in Brazil (www.visualnet.com.br).



PHOTOGRAPH BY MIGUEL BOYAYAN

Quickness and safety in multiple tests for optical components

Devices for optical networks

An innovative line of products aimed principally at the external telecoms market. That is the mission of FiberWork, a company from Campinas in the state of São Paulo, specialized in the area of communication through optical fibers. In little over four years of activity, it has developed solutions that involve the latest generation equipment, such the Optical S-Parameter Analyzer (Ospa), still rarely used in Brazil, but which is aimed at the American, European and Asian markets.

FiberWork was born in the incubator Supporting Center for the Development of High Tech Companies (Nade), in Ciatec, the Company for the Development of the Technological Excellence based in Campinas. In 2002, it moved to premises in a 1,100-square-meter business condominium, the Campinas High-Tech Companies Center.

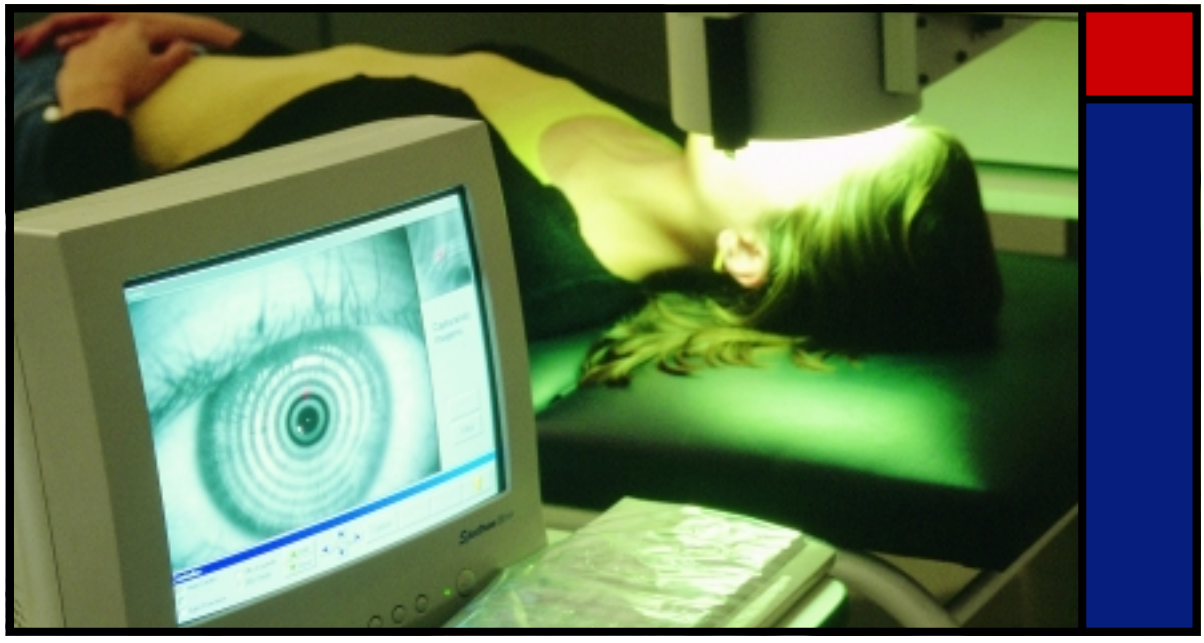
Ospa is a characterization tool for passive photonic devices – those applied in the optics , fiber optics, laser, display and optical communication industries. It carries out rapid and precise multiple tests for these components, measuring parameters such as dispersion, time delay, reflection, transmissity, losses and polarization responses. The tool uses original technology developed by the researchers of FiberWork, capable of measuring all these parameters simultaneously, in transmission and reflection, thus avoiding the use of several different instruments.

Ospa's target market is the manufacturers of devices such as optical filters, dispersion compensators, multiplexers which combine various transmissions in a single fiber, as well as routers and couplers used in optical fiber networks. The equipment was launched commercially at the beginning of 2004, at the main optical communications fair, in Los Angeles.

FiberWork is negotiating a partnership with an American company (the US accounts for 60 per cent of the photonics industry's world trade) which will be in charge of marketing of the product abroad. Besides Ospa, the company makes other pieces of equipment for the optical communications industry, and offers services such as planning, specification, installation, training and diagnosis of installed optical transmission networks.

According to the company Chief Technology Officer Sérgio Barcelos, the product has been well received since, besides having superior technology, its cost is lower than its competitors: around US$ 80 thousand, as opposed to US$ 160 to US$ 200 thousand for the products of other companies.

PHOTOGRAPH BY EDUARDO CESAR



Topographer coupled to the equipment prevents the appearance of astigmatism

More accurate eye surgeries

Good news for those who have to undergo a cataract or cornea transplant. Since April last year (2003), the two surgeries have become safer thanks to the corneal topographer developed by Eyetec, a small company specialized in the research and manufacture of ophthalmologic apparatuses, located in São Carlos, in the interior of São Paulo. The equipment ensures greater precision and eliminates most of the existing risks in surgical interventions. In the seven months since the launch of the product, 20 units of the apparatus have been sold at a cost of US$ 5 thousand per unit. Another innovation of Eyetec is a conventional topographer for image capturing, used before and after laser surgeries for the correction of myopia and astigmatism. This device, which costs US$ 12,4 thousand, has become the market leader in Brazil with 350 units sold.

The corneal topographer measures the curvature of the cornea during surgeries and detects very slight variations in the membrane surface, eliminating most of the risks in these procedures. The equipment prevents the appearance of astigmatism (distortions in the capturing of the image by the eye), a problem that ensues from extremely small alterations in the cornea surface at the moment of stitching up the surgical cut. The equipment took three years to develop. In the first phase of the project, mechanical and optical parts were produced and the image capturing and processing software was written. The next step was to create a prototype that would demonstrate the characteristics of a commercial product. The device also received a kind of mechanical arm which is used by doctors during surgeries. Ophthalmologists can choose between the two versions of the equipment: one that works linked to a desktop computer or one connected to a notebook,

To develop the equipment, Eyetec received financial support from FAPESP and entered into a partnership with several research institutions, such the Laboratory of Ophthalmic Optics of the Physics Institute of the University of São Paulo (USP) and the departments of Ophthalmology of School of Medicine of USP, of the city of Ribeirão Preto in the state of São Paulo, and the Federal University of São Paulo (Unifesp). Eyetec executives estimate that the product has good market potential, since out of the nine thousand ophthalmologists practicing in Brazil, about 3.6 thousand are surgeons, the target customers for the equipment. Furthermore, the topographer, which has already been patented, has a good chance of commercial success abroad. The company already has customers in Mexico and China and negotiations are underway in Europe.

New treatment against jaundice

A new piece of equipment to treat hyperbilirubinemia, a disease that afflicts newborn babies and is better known as physiological jaundice, has been developed by a company called Komlux, from Campinas, and should be launched on the market in July 2004. Dubbed Blanket Lux, the phototherapeutic blanket made from optical fibers presents a series of advantages when compared to the conventional treatment, which consists in exposing the babies to a light source generated by fluorescent or halogen lamps. Jaundice afflicts children all over the world and is characterized by the incapacity of the body to eliminate the bilirubin of the blood. Normally, this bile pigment is expelled by the liver or filtered by the placenta. When this does not occur, the most visible and common effect of the presence of the pigment in the baby is the yellowish color of the skin. In more severe cases, the disorder can damage the central nervous system and cause deafness.

Blanket Lux is a luminous mantle sown with modified optical fibers which emit blue light laterally and in a controlled way. The light is produced by a light source that works with a high efficiency halogen gas lamp in the region of the light spectrum indicated for the treatment. The blanket can be used directly on the baby's skin and it is not as uncomfortable as the traditional method in which the lamps cannot be put too close to the baby, otherwise they will burn the tiny patient. Moreover, unlike traditional phototherapies, Blanket Lux allows the therapy to be carried out either in the nursery or the maternity room. Since it is portable and weighs just 5 kilograms, the equipment can also be used at home. Another positive aspect is that with the blanket, there is no need to interrupt treatment to breastfeed. For healthcare organizations, the big advantage is the reduction of hospital stays.

The development of the phototherapeutic blanket took two and a half years of research and involved scientists from the State University of Campinas (Unicamp). The studies were funded by FAPESP. The equipment is now finished and in the final stages of certification with the Brazilian authorities. Each blanket in Brazil will cost about US$ 1,500, a lot less than the main competitor's product, made in Japan, which costs US$ 8,000. The export product will be even cheaper due to tax exemptions (US$ 1,000). According to Komlux, world demand for the product is about 3,500 units a year. The company's production capacity is about 5,000 blankets a year. To win the European market, Komlux is implementing the ISO 13.485 standardization certification which attests the quality of medical products. The company also expects to sell Blanket Lux in the United States where a similar products goes under the name of biliblanket.

PHOTOGRAPH BY MIGUEL BOYAYAN

Therapy is comfortable and avoids the interruption of breastfeeding

Komlux was formed in 1986 to produce dental tips for photopolymerization, equipment which dries the mass used in dental reconstruction. This project was later sold to the multinational 3M, and the partnership was dissolved. In the same year, Komlux signed a service contract with Elebra, also from Campinas, which was already involved in the production of optical fibers for telecommunications. Komlux developed endoscopes for medical use, and between 1994 and 1995 commenced the development of the fiber optical blanket with the support of the Ministry of Science and Technology (MCT), through the Technological and Scientific Development Support Program.

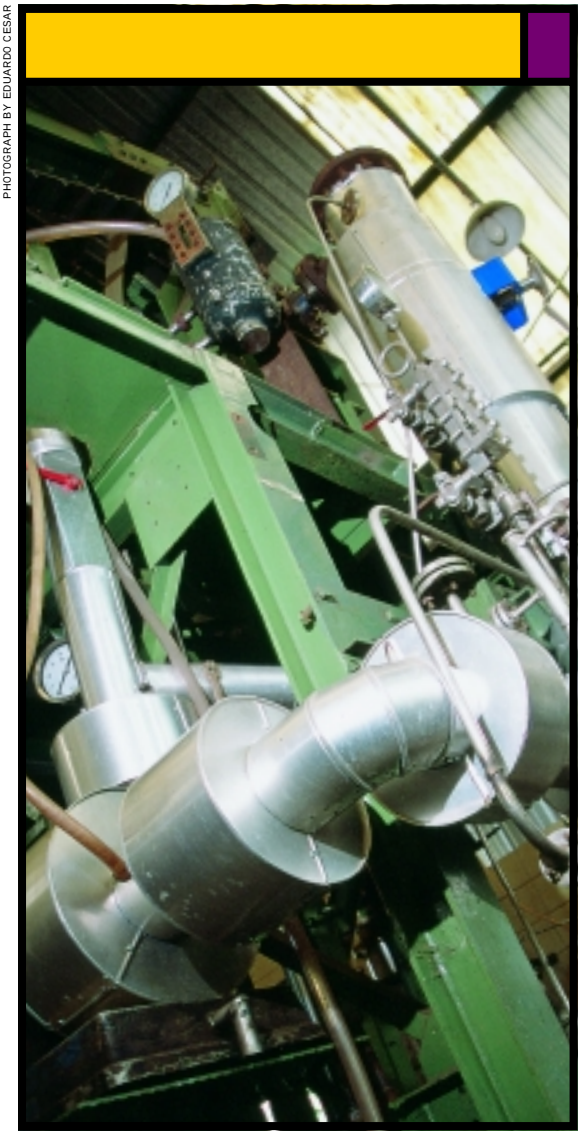
Sugarcane bagasse becomes alcohol fuel

To produce carbureting ethylic alcohol – ethanol – from sugarcane bagasse. What seemed to be a dream some decades ago has come true thanks to the efforts of the scientists of the Grupo Dedini, a company with headquarters in Piracicaba, in the interior of the state of São Paulo. One of the largest Brazilian manufacturers of machines and equipment for the sugar and alcohol industry, at the end of 2003 Dedini opened, a semi-industrial plant, called a Process Demonstration Unit (PDU), capable of using the total biomass of the sugarcane and turning the bagasse into fuel alcohol. With this innovation, the company is confident that it will be possible to increase production of ethanol in the country by 30 per cent without the need to plant any additional sugarcane. This is equivalent to an additional supply of 5.4 billion liters of alcohol a year.

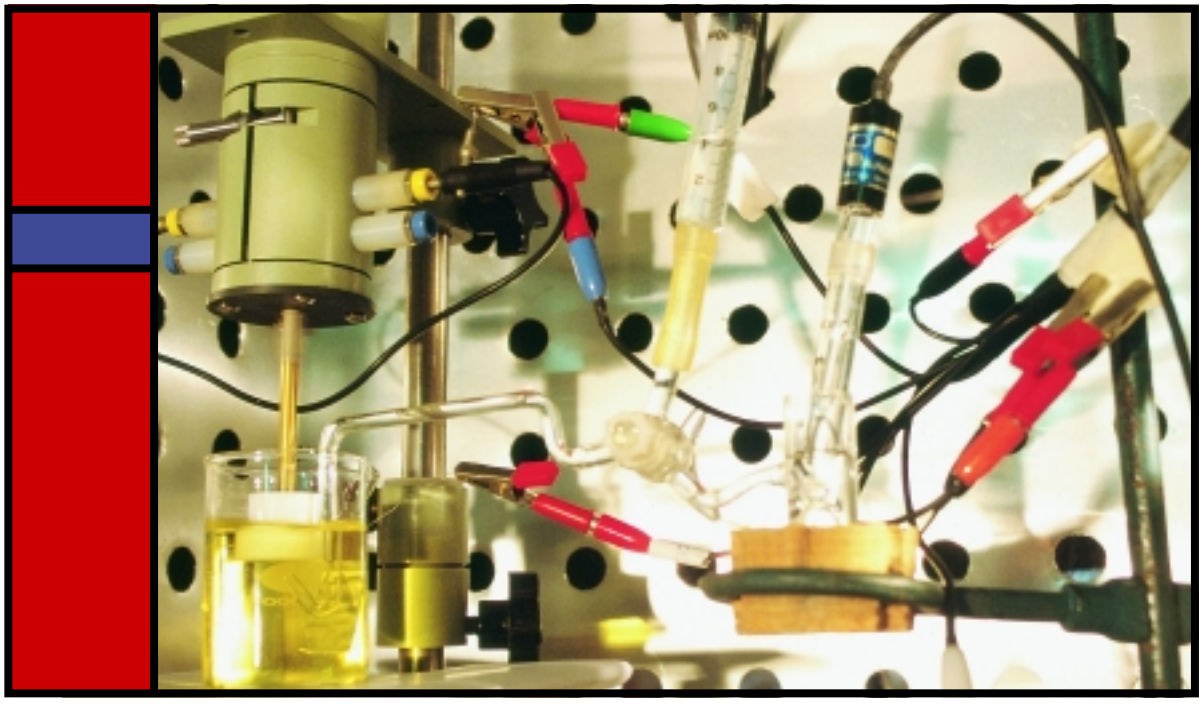
The new technology is the result of two decades of research in which Dedini teamed up with the Center of Technology of the Cooperative of Sugarcane, Alcohol, and Sugar Producers of the State of São Paulo (Copersucar) and the company received funding from FAPESP. To achieve their aim, the researchers of Dedini and the Copersucar Center of Technology had to develop a process based on hydrolysis (chemical reaction with the use of water) which converts the cellulose present in bagasse into ethanol. Dubbed Dedini Rapid Hydrolysis (*Dedini Hidrólise Rápida* – DHR in the Portuguese acronym), the technology is patented in Brazil, the United States, the European Union, Russia and several other Latin American countries. The great advantage of the process is its speed. While the traditional process required the use of concentrated or diluted acids and took five hours to effect the transformation, the DHR technique takes less than ten minutes.

The process is relatively simple. The sugarcane bagasse is placed into a continuous flow reactor which is supplied with an organic hydrosolvent – preferably ethanol – and sulphuric acid. The unit operates under 25 to 27 kg/cm^2 pressure and at a temperature close to 190 degrees Celsius. In just a few minutes, the cellulose and the hemicellulose present in the bagasse are transformed into hexoses and pentoses, with glucose dominating amongst the formed hexoses. The hydrolytic liquor containing the reducing sugars is purified to extract the undesired substances, mainly the sulphuric acid, and nutrients are added, creating a fermentable must, which is blended with the juice and the molasses normally used in alcohol production. In the final stages of the process, the mixture is fermented and distilled into ethylic alcohol. Dedini expects to complete the development of the first industrial plants, with a capacity to produce 60 thousand liters of alcohol per day, around mid-2004. Once this happens, the technology will be available to any interested companies.

PHOTOGRAPH BY EDUARDO CESAR



New technology extracts 30% more alcohol form sugarcane



PHOTOGRAPH BY MIGUEL BOYAYAN

Bleaching process produces cellulose with less harm to the environment

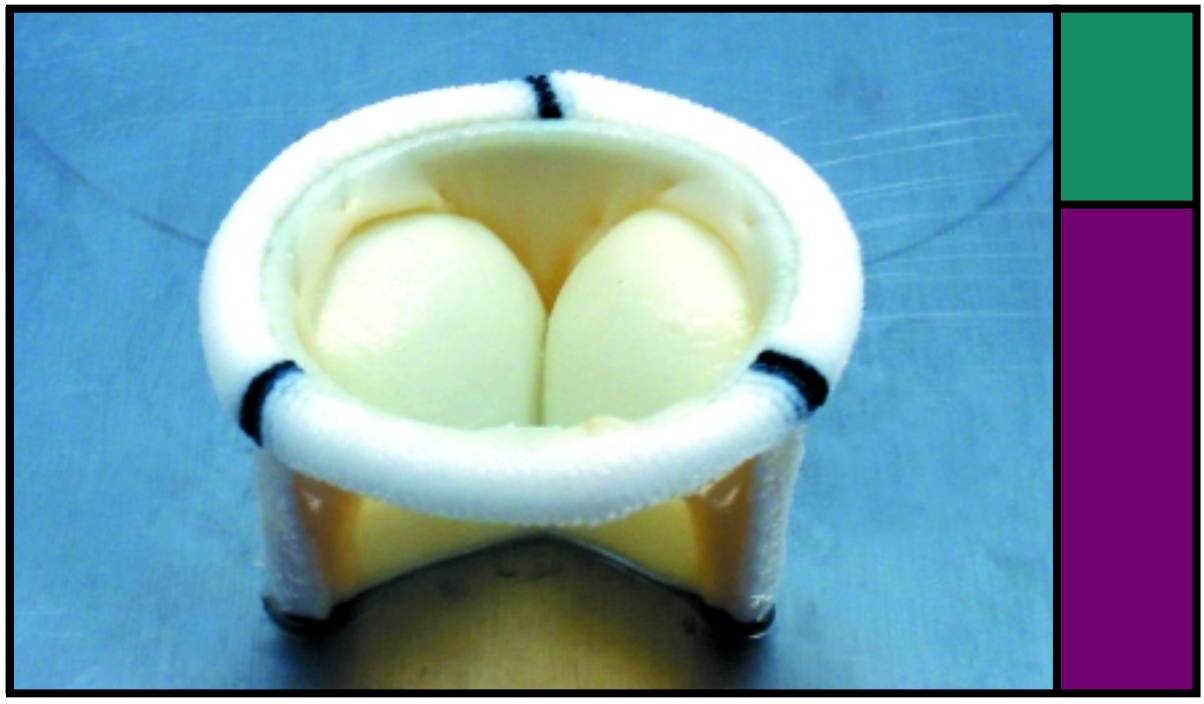
Product improves cellulose bleaching

Brazil is one of the great world producers of paper and cellulose, and thanks to the efforts of a chemical company from Barueri, in the metropolitan region of São Paulo, the process of cellulose manufacturing has become more efficient and less harmful to the environment. In 1999, Logos Química developed the Logosperse family of multi-functional chelating agents which eliminate undesirable metallic compounds in the bleaching of eucalyptus cellulose pulp. The great advantage of the product is the fact it is harmless to the environment. Discovered after two years of research, Logosperse provided an alternative to the use of diethylene triamine pentaacetate acid (DTPA), the only substance used for this purpose in those days. The new chelating agent was swiftly accepted by the industry and today is the leader in its sector.

The Logosperse line combines three molecules based on phosphonates synthesized in Logos's own laboratories. According to the Logos researchers, the new family of chelating agents reduces the use of hydrogen peroxide, the popular oxygenated water, in the bleaching of cellulose, and other inputs, thus slashing costs by 50 per cent. The role of the substance is to "trap" metallic ions such iron, copper and manganese which are present in the brown cellulose pulp, which otherwise, would react with oxygen peroxide, degrading it and damaging the whiteness of the product. Another advantage of Logosperse in comparison to DTPA is that it can be employed both in alkaline and basic solutions, while DTPA is only efficient in the basic. This versatility reduces production costs and lowers the corrosion in the equipment and stainless steel components used in the paper and pulp industry.

Created in 1990, Logos Química's portfolio includes large customers such as the Brazilian paper and pulp companies, Aracruz, Votorantim and Suzano Bahia Sul, and competes with giants of the international chemical industry (Dow, Basf and Monsanto). The secret of the company's commercial success – it employs 150 staff and has yearly revenues of US$ 10 million – lies in the importance the company gives to research and development. Logos invests 3 to 5 per cent of its income in R&D and a large part of the company's revenues is the fruit of products launched over the last few years. During the development of the line of chelating agents Logosperse, the company was funded by FAPESP though its Small Business Innovation Research Program (PIPE).

PHOTOGRAPH BY BRAILE BIOMÉDICA



Stable material and rejection proof increases the durability of cardiac valves

Longer life for cardiac patients

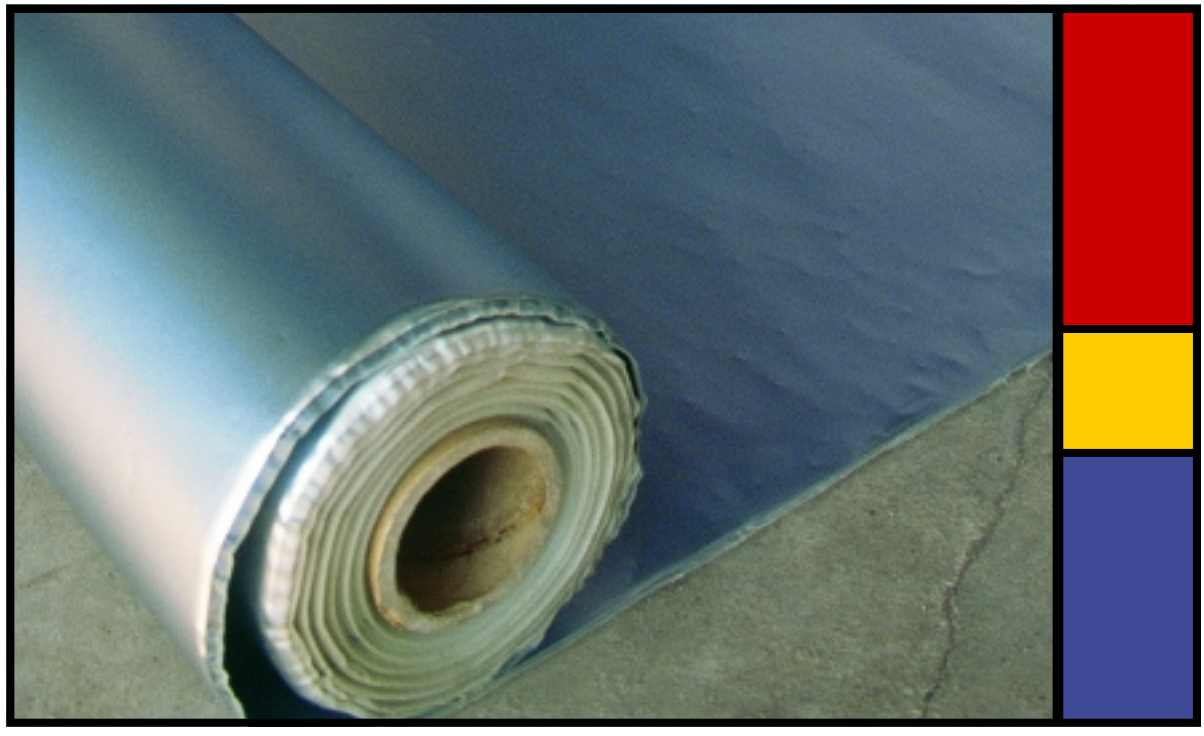
Among the companies that comprise the "medical industry" in Brazil, Braile Biomédica from São José do Rio Preto in the state of São Paulo stands out. Its path is marked by partnerships with research institutions for the development of cardiology products. One of the latest innovations introduced by the company is also a result of this alliance. It is a new material to produce biological cardiac valves, jointly developed with the Chemistry Institute of the University of São Paulo (São Carlos campus) under the supervision of the researcher Gilberto Goissis.

Bovine pericardium, before being used for the production of biological valves, goes through a chemical stabilization process – fixation with glutaraldehyde – to improve its mechanical properties and lessen the occurrence of rejection through calcification. In the conventional process, the protection achieved is only superficial and after seven years' use of the valve, the organism triggers a process to eliminate the material. In the new technique, the very same glutaraldehyde is used for stabilization but a chemical change is inserted into this chemical reagent. The change results in the production of biologically more stable material which, according to studies, increases the durability of the valves and the life of patients.

"The stability of the pericardium with perfected treatment was greater than the conventional one, that is why better results are also expected in clinical practice," observes the director of the company, surgeon Domingo Braile, pointing out that all other products made with pericardium are using the new technology. The kind of valve to be used in heart surgeries depends on the patient and on the doctor, and the world trend shows a very promising market for the latest generation of biological valves, mainly those made of bovine pericardium. It is estimated that this market will grow 7 per cent a year.

Braile Biomédica, specializing in medical products for heart surgery, was founded in 1977, when it began producing the biological heart valves and bovine pericardium grafts used in heart surgery.

Brazilian demand for valve protheses is about 1,100 units/month, of which 70 per cent are biological valves (porcine and bovine) and 30 per cent are mechanical. According to Braile, the company produces around eight thousand biological valves a year and has approximately a 60 per cent share of the national market.



PHOTOGRAPH BY EDUARDO CESAR

Product blends two industrial residues and is approved in tough tests

Sealant for civil engineering

A new sealant for use in civil engineering is ready to be launched on the market. Derived from the combination of two types of industrial residue, patents for the product are being sought in Brazil and in the United States. The new product, called resin-composite, has been tested for the last three years at 40 construction sites in the city of São Carlos in the state of São Paulo by Athena Engenharia.

The idea for the product came out of the experience of company owner and civil engineer, Celso Martinez Junior, who is especially interested in the application of new materials that offer greater durability and avoid the need for constant repairs in water repellent structures.

The formulation of the resin-composite combines two industrial byproducts. The first comes from the manufacture of styrene, a chemical product used in the plastics industry and which already figures among construction resins. The other is scrap aluminum sheet, a material used in the internal coating of telephone cables along with a plastic cladding.

The research that led to the creation of the sealant was carried out in partnership with Professor Fazal Hussain Chaudhry, of the Department of Hydraulics of the Engineering School (São Carlos) of the University of São Paulo (USP).

The research was based on theoretical studies and on several tests that simulated environmental conditions such as light, heat and rain. In order to prove the effectiveness of the product's durability and resistance, the samples were also successfully put through impact testing.

The system is intended for constructions where the cement slab is only occasionally stepped on (maintenance and cleaning purposes), and is not recommended for places in which people and vehicles transit.

According to Martinez Junior, the tests were carried out on residential places, for example on the slabs over garages, and on the marquees of commercial buildings. The technology is currently being applied in the waterproofing of a large stadium cover (about 10 thousand square meters), in the São Carlos region.

With a business plan already in hand, the entrepreneur is seeking funds for the purchase of the equipment and the construction of a model factory for the production of the new product.

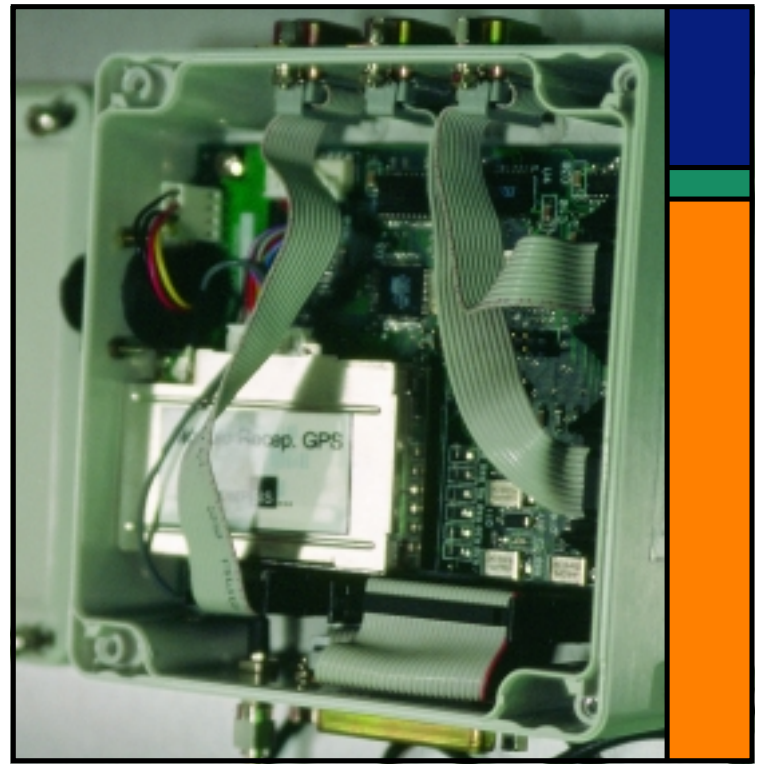
Keeping an eye on vehicles

A device the size of a cigarette pack is optimizing the operation of fleets of public transport companies and ensuring the safety of cargo transportation in Brazil. It is the Onboard Vehicle Control and Tracking Computer, developed by Compsis Computadores e Sistemas, from the city of São José dos Campos, São Paulo. The equipment, the technology of which is based on the traditional vehicle tracking systems, adds to conventional tracking a series of options provided by information technology, such as the mapping of the driven route and detailed time-keeping reports. It uses the GPS (Global Positioning System), system that employs information from a constellation of satellites to keep track of the vehicle's location. The data is sent to the company through UHF radio stations or mobile phone systems.

Launched on the market in the middle of 2002, the device costs between US$ 840 and US$ 1,600, depending on the specification. Given its capacity to monitor everything that occurs within the vehicle, the onboard computer is like an aircraft black box. It can be programmed to register such activities as fuel consumption, speed at every point of the way, the opening of the doors, the duration of stops and the temperature of a cold cargo, if the vehicle is carrying one. Furthermore, it also can be configured to perform the electronic check-in at a company entrance gates, automatic payment at tolls and gas stations. One of the great benefits of the equipment, that needs to be kept concealed in the vehicle to avoid being tampered with, is that it allows the on-line monitoring of the vehicle, thus providing an efficient tool against cargo theft. If the vehicle strays from the planned route, the device can turn off certain systems, taking over the control of the engine ignition, the opening of the cargo compartment, the headlights, the door locks and the radio, and sending a warning signal to the central station or to the security company or law-enforcement agency.

Besides freight companies, other major clients of Compsis, which has fifteen years of trading behind it, are public transport providers. In the management of a bus fleet, the onboard computer can register the time spent at each stop, the mileage, average speed and routes driven. A contract has already been signed with São Paulo Transporte, a company that manages public transport in the city of São Paulo. It can be employed to track the path of garbage trucks, registering the tonnage that the vehicle is carrying and the place it unloads it. Independent of its use, the equipment can be configured for several memory capabalities and also offers the possibility of encrypting the collected data. And to make the reading of the information easier, the onboard computer produces graphs, and exchanges information with Microsoft Office files.

Compsis was created in 1989, when it began its activities as supplier for the aerospace industry of São José dos Campos. In the last few years, the company has installed electronic tolls and developed software and electronic equipment for the the auto industry assembly lines.



PHOTOGRAPH BY EDUARDO CESAR

System brings safety to cargo transporters

Vegetable fibers in constructions

A novelty in the Brazilian construction industry: tiles and water tanks made from a mixture of vegetable and plastic fibers, without the presence of amianthus (long silky asbestos), a material considered to be carcinogenic. This new kind of fiber-cement, with high durability and resistance, was developed at the School of Zootechny and Food Engineering (FZEA, Pirassununga in the state of São Paulo) and the Polytechnic School, both belonging to the University of São Paulo (USP).

As project coordinator professor Holmer Savastano Júnior explains, the new technology incorporates the use of vegetable fibers from timber such as pine and eucalyptus, and non-timber such as sisal, banana trees and coconuts. The plastic fibers enter in the composition as reinforcement to the cement "significantly improving the mechanical performance and the durability of these materials," he states.

Two companies signed a partnership with the FZEA and the Polytechnic for the production of this material: Imbralit, based in the city of Criciúma in Santa Catarina state) and Infibra/Permatex from Leme in the state of São Paulo. According to Infibra/Permatex's industrial director, engineer Luiz Fernando Marchi Júnior, out of a total of 6,000 water tanks produced every month, around 3,000 contain no amianthus. "It's a growing market that satisfies consumers from Brazil and abroad who demand differentiated products," observes Marchi Júnior.

Corrugated roofing without asbestos, also produced by the company, will be on the market in the second semester of 2004. Although the new products are on average 20 per cent more expensive than existing ones, the expectation is that the optimization of the material for existing uses, as well its improved adaptation to the market and climate will result in better cost/benefit ratio to the end consumer.

The study of alternatives solutions for construction materials will not end here. The intention, according to Savastano Junior, is to use asbestos-free formulations in other types of components such as internal walls, panels, ceilings and floors. Furthermore, other raw materials are being researched – such as high furnace slag and sugarcane bagasse ashes – as partial substitutes to the conventional Portland cement in the production of fiber-cement.

PHOTOGRAPH BY MIGUEL BOYAYAN

New type of material replaces asbestos in tile production

PHOTOGRAPH BY MIGUEL BOYAYAN

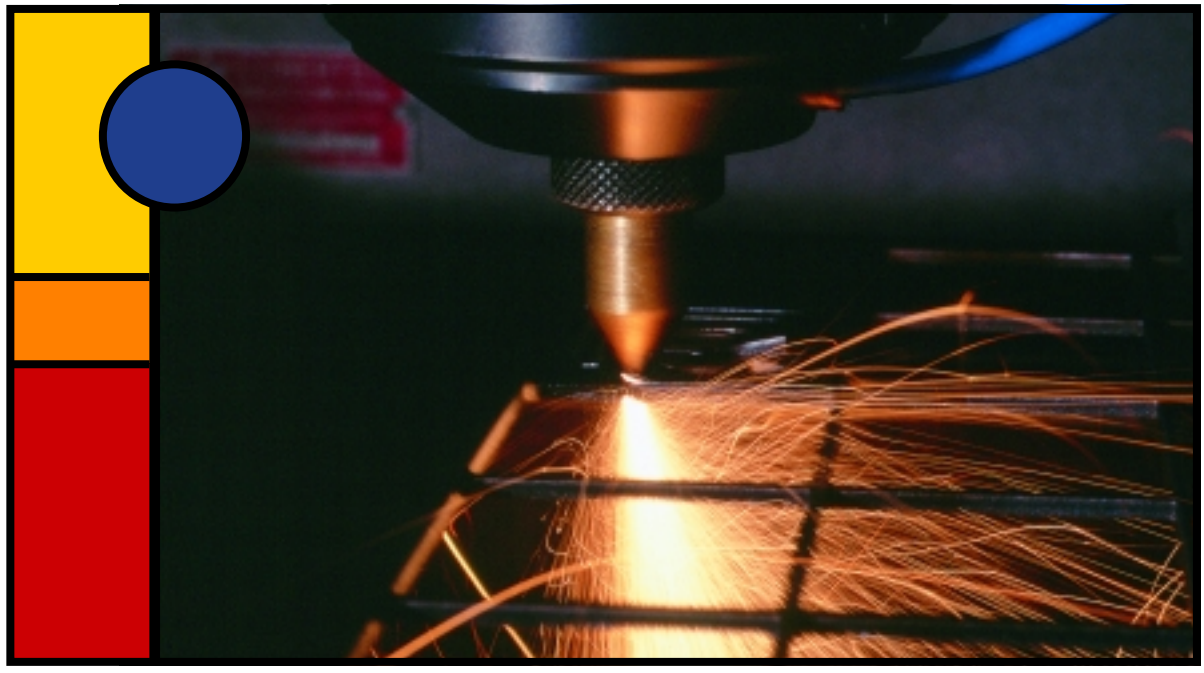
Reproduction of predator insects of several agricultural pests

Insects fighting insects

A small company located in Piracicaba, in the interior of the state of São Paulo, has been an international success story thanks to the production of insects used in the fight against agricultural pests. Created just two years ago, Bug Agentes Biológicos already sells its products to eight customers from five countries: Switzerland, United Kingdom, Italy, Belgium and Mexico. In addition, another 34 customers in Brazil – agricultural cooperatives, associations of rural producers, sugarcane mills and farmers – use the insects grown at Bug. The main export product is the egg of the *Anagasta kuehniella* moth, used by the *Trichogramma* wasp for its reproduction – this wasp is a natural predator of various agricultural pests. "Practically half of our monthly production of 34 kilograms of moth eggs is sold abroad. This amount is enough to spawn approximately 2 billion predators of insects harmful to agriculture", says the agronomist Diogo Rodrigues Carvalho, one of the directors of the company.

Biological pest control is a concept that appeared in the 60's in the United States and Europe replacing the then common trend of using chemical insecticides. The first insects sold in the United States for biological control in gardens and greenhouses were the ladybugs. In Brazil, the first experiences, which were aimed at the sugarcane borer (*Diatraea saccharalis*), go back to 1950. Biological control has several environmental, economical and social advantages compared to the use of insecticides. In the case of the sugarcane borer, for instance, a pest that attacks the sugarcane crops, biological control, which includes the parasites, freight and application costs around US$ 5 per hectare as opposed to US$ 15, on average, for chemical control.

Bug has 40 employees who take care of the insects' diet and select the most vigorous ones to fight the pests. The company is producing four parasitoids (*Cotesia flavipes*, *Trichogramma pretiosum*, *T. galloi* and *T. atopovirilia*) and eggs of two types of insects (*Anagasta kuehniella* e *Sitrotoga cerealella*). The parasitoids use the pest as a host and end up killing it, while the eggs can either be food for the natural predators of the pests or promote the reproduction of the parasitoid. Biological control can be done on several crops, such as sugarcane, corn, tomatoes, fruit trees, avocados, some citrus, green vegetables and flowers among others. By the end of the year, Bug predicts that 100 thousand hectares will be using its insects, 80 per cent of them corn crops. Due to the vast cropland in Brazil, the company's growth potential is enormous. "We are evolving, in terms of production and the amount of cropland attended, around 200 per cent a year," celebrates Diogo Carvalho.



PHOTOGRAPH BY FLÁVIO CANNALONGA

Laser to engrave parts used in plastic injectors

A thousand and one uses of laser

Services in the area of processing materials with the use of lasers is the specialty of LaserTools, a technology-based company in the state of São Paulo. The company was created at the end of 1998 by seven partners whose academic and professional backgrounds come from the Applied Optics Division of the Institute for Nuclear Energy and Research (Ipen in the Portuguese acronym). During its first years of activity, LaserTools operated out of the Incubator Center for Technology Companies (Cietec) in São Paulo, but moved into its own premises in 2002. The company presently employs 35 people and serves around 600 customers throughout Brazil, and some customers in the United States. Its success can be measured by the evolution of the company's revenues which grew 15 per cent last year and 100 per cent the year before. LaserTools' gross revenues are about US$ 400 thousand yearly.

The company does not exactly offer a product, but rather a service that uses laser technology to add value to various materials and pieces of equipment. One of the focuses of the company is the surface marking of parts and products with the use of laser. LaserTools also makes high-precision cuts with measurements such as 30 micrometers (a micrometer is a meter divided into one million parts), holes sized from 20 to 100 micrometers, welding without heat propagation, heat treatments and surface and deep engravings. To carry out all these tasks, the company uses a type of laser called neodymium (Nd): YAG solid state. Neodymium is a chemical element known as rare earth and YAG is a synthetic crystal, made of yttrium aluminum and garnet, hence the name YAG.

LaserTools today operates in three industrial sectors: in the precision engineering sector (especially in engravings and molds for the plastics industry), in the medical-dental industry (surgical tools and implants) and in the advertising industry. According to physicist Spero Penha Morato, one of the partners of the company, the use of laser for processing materials has innumerable advantages when compared to conventional processes. It carries out with greater precision and better quality almost all the tasks that traditional tools execute and it is more economical, as it offers good reproducibility with high efficiency. Furthermore, the uses of laser are wide ranging and very flexible – it has been used for cutting, drilling, marking, welding and surface treatment – and can be applied to several materials, such as metals, alloys, ceramics, fiberglass, plastics, wood and kevlar.

Watching the reservoirs

Brazil has an efficient tool to control and monitor its reservoirs which have a capacity of about 1,000 cubic kilometers of water. This system, created by the International Institute of Ecology (IIE in the Portuguese acronym), located in São Carlos, a university city 240 kilometers from the city of São Paulo, allows the integrated management of reservoirs and dams, reconciling the multiple uses of these water bodies, such as energy generation, irrigation, navigation, fishing, fish farming, tourism and recreation. The system is already being used in some Brazilian reservoirs and has been arousing the attention of some international bodies. Evidence of this is the signature – in December 2002 – of a cooperation contract between the IIE and the American Army Corps of Engineers, the biggest reservoir management institution in the world. "This agreement predicts joint management projects which will be implemented all over the world, based on our module", says researcher José Galizia Tundisi, director of the IIE and former president of the National Council for the Scientific and Technological Development (CNPq in the Portuguese acronym).

Studies for the creation of the system began in July 2002 and involved researchers from four countries. Besides Brazil, specialists from Denmark, Spain and the Czech Republic took part in the project. The main component of the system is the software with models of hydrodynamic measurements (in which all the circulation elements of a reservoir are taken into consideration), sediments, transport and water quality. One of the by-products is the Water Monitoring System in Real Time (Smart in the Portuguese acronym), a station installed on a platform that is anchored in the reservoirs, continuously transmitting data, via radio, to the computer at the dam, thus allowing the operators to assess the quality of the reservoir water. The data is sent to the institute by the Internet. This integrated and predictive management system can be applied to hydroelectric reservoirs and to the public water supply. Its use will increase the capacity of optimization of the multiple water uses, carrying an overall evaluation of the impacts and processes on the river basin and their repercussion on water quality and on the functioning of the reservoir itself. It can be used in reservoirs of any size and volume and has economic repercussions in the management of reservoirs and river basins.

In addition to this hydric management, the development of which was supported by FAPESP through its Small Business Innovation Research Program (PIPE), IIE develops research and produces publications, carries out training and organizes events in freshwater limnology (the study of fresh water and its organisms), hydric resources, management and environmental modeling. According to Tundisi, the institute was conceived to undertake consulting assignments and projects with classical research, but was born with a vocation to transform existing knowledge into innovation and products. Which is exactly what it excels at, despite the little time it has been in existence,.

PHOTOGRAPH BY EDUARDO CESAR

Automated probe submerses 28 meters

FAPESP TECHNOLOGICAL INNOVATION PROGRAMS

Genome Program

- *Xylella fastidiosa*
- Functional
- Sugarcane
- Human Cancer
  - Clinical Genome
  - Cancer Transcriptome Initiative
- Xanthomonas
- AEG: *Xylella fastidiosa* PD, *Leifsonia xyli*, Coffee, Eucalyptus, *Xylella* of the Oleander and *Xylella* of the Almond Tree
- *Schistosoma*
- Bovine Functional

BIOTA - The Virtual Institute of Biodiversity

Public Policies Research Program

CEPID - Research Innovation and Diffusion Centers

PITE - Industry / Research Institution Partnerships for Research and Development

PIPE - Small Business Innovation Research

ConSITec - Sectorial Consortiums in Technological Innovation

PAPI/NUPLITEC - Support Program on Intellectual Property

TIDIA - The Information Technology on the Development of an Advanced Internet

SMOLBNet - Structural Molecular Biology Network

VGDN - Virus Genetic Diversity Network

SIHESP - Integrated System of Hydro-Meteorology in the State of São Paulo

FAPESP

Rua Pio XI, 1500 - Alto da Lapa
CEP: 05468-901 - São Paulo - SP - Brasil
Tel: 55.11.3838-4000
Fax number: 55.11.3838-4117
info@fapesp.br
http://www.fapesp.br

SECRETARIAT OF SCIENCE, TECHNOLOGY, ECONOMIC DEVELOPMENT AND TOURISM

GOVERNMENT OF THE STATE OF SÃO PAULO

GOVERNO DO ESTADO DE SÃO PAULO
RESPEITO PELAS PESSOAS