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# ***JPRS Report***

# **Science & Technology**

***Europe & Latin America***

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SCIENCE & TECHNOLOGY  
EUROPE & LATIN AMERICA

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## DANISH S&amp;T COUNCIL PROPOSES 2 BILLION FOR MATERIALS RESEARCH

Copenhagen BERLINGSKE TIDENDE in Danish 25 May 87 Pt 3 p 7

[Article by Henrik Damm]

[Text] The State Scientific and Technical Research Council is now proposing that, during the next 10 years, the state and the industry invest about 2 billion kroner for research on new materials. The industry is now able to manipulate the composition of atoms in materials just like biologists can do with genes.

Why take a large piece of steel, bore and cut it, in order to make a "material," when you can just as well use powder, place it in a form, and make the same "material" far cheaper and more durable?

Well, this is only one example of many in our lives today and in the future we are entering. For this reason, Industry Minister Nils Wilhjelmsen (Conservative Party) and Education Minister Bertel Haarder (Liberal Party) now have a specific proposal on their desks from the State Scientific and Technical Research Council, the State Natural Science Research Council, and the Technology Council that would result in increased research on new materials. If the project is approved, it will cost 2 billion kroner over the next 10 years.

"We now know that the properties of materials begin down on the atomic level. When cars rust, it is because layer after layer of iron atoms are oxidized and fall off. When a windmill is strong enough to withstand a strong autumn storm, it is because the individual plastic molecules hold firmly together in the plastic fibers and when optical fibers can transfer enormous quantities of information practically without losses, then it is because the purity, composition, and concentration profiles used in production can be controlled with unbelievable accuracy," a member of the State Natural Science Research Council, section leader Jorgen Kjems of the Physics Department of the Riso Experimental Station at Roskilde, said at a presentation of the program.

One of the things Jorgen Kjems stresses is that physicists and, thus, a large sector of the manufacturing industry, have "stolen" the tricks that are used by biologists. Biologists can manipulate genes and, in the same

way, it is possible to manipulate the properties of materials--to the benefit of the industry and of the consumer. As an example, Jorgen Kjems mentions the next generation of computer chips. They will be much faster and far more sensitive than existing chips because the technicians themselves made up the "recipe."

#### Layer Cake With Icing

"In the trade, it is called molecular epitaxy, but it is known more popularly as layer cake with icing. The chips are made according to the same principle and the producer himself stacks up the molecules according to his wishes," Jorgen Kjems said. He stressed, however, that this technique is not yet available here in Denmark--neither in the laboratory nor on the production level. But this is one of the things the 2 billion will help us acquire.

#### Lines Without Losses

The transfer of information has always been the very foundation of all organized societies. The Indians used smoke signals--a large or a small puff of smoke. Today's telecommunications companies use a similar method in their digital systems--a "zero" or a "one." The light is simply converted to these quantities before it is transmitted through the new communications network--fiber optic cables.

There is also news concerning another type of conductor--so-called superconductors or conductors that transfer electricity without energy losses. They will be cheaper for the company and, ultimately, for the consumer, as well.

Jorgen Kjems does not doubt for a minute that, 10 years from now, the electrician or the hardware salesman will ask us if we want a "regular appliance or a superconductor."

"Superconductors will revolutionize all production, distribution, and consumption of electricity. This technology will make it possible for trains traveling under the Great Belt to float on superconducting magnets," he said.

#### Areas Of Program

The development program for materials technology, which is primarily directed toward the future of Danish industry, will concentrate on the following major export-oriented areas:

- Iron and metals industry (including technical ceramics);
- Electronics industry;
- Plastics industry;
- Wood industry;
- Building and construction (including offshore);
- Clothing and textile industry.

Deeper down, on the level of individual materials, the following will be of great interest in the future:

- Metal-based materials;
- Plastic-based materials;
- Ceramic materials;
- Cement-based materials;
- Electrical, magnetic, and optical materials;
- Wood-based materials;
- Flexible materials (textiles, etc.);
- Fiber technology;
- Powder technology;
- Surface technology;
- Sampling methods;
- Gene utilization;
- Materials testing.

#### We Can Be Included

Other countries are already deeply involved in these important areas of research, but according to Jorgen Kjems, there is no reason for doubt.

"We can also participate, but we must make a choice. We have the educational, research, and coordinating institutes and I believe we also have a far-sighted industry. But if we are to participate, we must consolidate and coordinate our efforts. If we do so, materials technology could become a Danish specialty," Jorgen Kjems said.

9336

CSO: 3698/487

DENMARK TO PARTICIPATE IN EUROPEAN SPACE PROJECTS

Arianne 5, Hermes: 50 Million Annually

Copenhagen BERLINGSKE TIDENDE in Danish 23 May 87 Pt 3 p 1

[Article by Carl Otto Brix]

[Text] A majority in parliament, excluding the government, wants Denmark to participate in the European space research programs Arianne 5 and Hermes.

A parliamentary majority now wants to force the government to let Denmark participate in the EC space programs Arianne 5 and Hermes, which include a rocket and a space shuttle. It will cost 50 million kroner per year for 10 years, but most people believe that Denmark will get more than this in return.

Yesterday, Education Minister Bertel Haarder (Liberal Party) and Industry Minister Nils Wilhjem (Conservative Party) discussed the matter in the Market Committee and, once again, they rejected the idea of Danish participation.

Bertel Haarder told the committee that, if Denmark were to participate, it should have happened 1.5 years ago. Joining now would be like sneaking in the back door.

Nils Wilhjem said it would be better for Denmark to invest additional funds in the Eureka Project and he pointed out that the Industry Council agreed with the government.

"It is clear," Ivar Norgaard (Social Democrat) said. "The Industry Council can only support projects that are beneficial to all its members and, for this reason, the council is an obstacle to high technology development in this country."

Ivar Norgaard pointed to the Research Council and the electronics industry, which have recommended Danish participation. The Electronics Council believes that the 50 million kroner in investments would give Denmark three times that amount in return.



"The government says it favors certain industrial subsidies," Norgaard continued. "Now it has the chance to do so and it refuses."

Nils Wilhjelm said it was no wonder that the industry was anxious to participate. "Some industry leaders believe that all public subsidies to them are good," he said, "But we in the government must set economic priorities."

The majority will now decide whether its instructions to the government will be in the form of a proposed resolution or a document to the finance committee.

#### Participating Companies

Copenhagen BERLINGSKE TIDENDE in Danish 23 May 87 Pt 3 p 2

[Article by Steffen Kretz]

[Text] The electronics industry is rejoicing over the decision to let Denmark participate in the European space research program. It is expected that the investments will be recovered in the form of contracts to Danish industry.

"An extremely wise decision that will be of enormous benefit to the Danish high technology industry."

This is how director Christian Roving described the decision of a majority in parliament, according to which Denmark will participate in the European space program to produce the Ariane 5 rocket and the Hermes space shuttle.

This cooperation will give the entire industry a technological lift. Companies will now gain access to research and knowledge that they could not have in the past, according to Christian Roving. He was supported by Ove Lunddorf, head of the space research division at Terma Elektronik.

"Without these investments, the Danish space industry could not keep up with its competitors abroad. The money that will be spent on this program will be particularly fruitful. Past experience has shown that at least 85 percent of the money comes back to Denmark in the form of contracts with Danish companies."

Knowledge gained from the program will also help companies enter the commercial space market, i.e. the launching of private TV satellites, for example," Ove Lunddorf said. Initially, five or six Danish companies in particular will profit from the space project. In addition to Christian Roving of 1984 and Terma, these include CRI, Ticra, Kampsax, and ElektronikCentralen.

The chairman of the Electronics Manufacturers' Association also welcomed the decision, although he "respects the Industry Council's opposition", which is based on Danish industry as a whole."

The industry believes that, a little further down the road, the program will mean more jobs for both engineers and technicians.

## FRG OFFICIALS DEBATE PLANS FOR NATIONAL AEROSPACE CENTER

Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 452, 27 Mar 87 pp 4-5

[Text] "We need a national German institution where all aerospace activities are planned, coordinated, and carried out. The United States, Japan, and France have had national aerospace organizations for a long time. Britain and Italy as well as smaller European countries like Sweden and Norway have created them recently or plan to create them." FRG Foreign Minister Genscher affirmed this in his speech to the First German Economic Congress in Cologne. Europe has to achieve autonomy in space in order to continue cooperating with the United States as a partner.

Prof Dr Reimar Luest, the general director of the European Space Agency (ESA), said that the more you can contribute to cooperation, the more successful it is. According to Luest, considerably increased financial efforts are certainly necessary, as the Americans spend 16 times as much per capita as the Europeans on space. Luest called for ESA resources to be doubled from current levels.

Also, the Industrial Plant Management Company (IABG) gave clear priority to the establishment of a National German Space Agency within various models in its study on behalf of the BMFT [Federal Ministry for Research and Technology] on "decisionmaking structures and processes in the space field in the FRG." The study also states that the German Research and Experimental Institute for Aeronautics and Astronautics (DFVLR) seems to be overburdened with coordination and management tasks. A more effective technology promotion policy would strengthen aerospace organizations. At present, the inadequate technology policy raises expectations about aerospace commercialization far too high. Aerospace must be interpreted as a government responsibility if the current aerospace potential of larger firms is to yield some results.

Genscher's comments were heavily criticized by the SPD. European autonomy in aerospace should be ensured, according to the SPD, by the ESA's two main projects: the Ariane 5 launcher and the Hermes manned space vehicle and by European-American cooperation in the space station project. The only thing that is clear at this point is that the federal research minister, who is formally responsible for this field, cannot pay for this from his budget.

Furthermore, according to the SPD, European cooperation with NASA is on the brink of a final breakdown over the question of "peaceful use" of the space station. The U.S. Department of Defense is going to use the space station for "national security objectives," i.e., militarily.

In addition, the SPD feels the fragmentation of Germany's aerospace activities among the ministries, research institutions and companies can hardly be overlooked any longer. The new organization that the federal foreign minister calls for in accordance with the IABG study only makes sense if it is clear which relevant objectives will be pursued and how the government should raise the necessary funds.

8702

CSO: 3698/M242

## FRG INSTITUTE TO FOCUS ON BIO-INFORMATION PROCESSING

Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 454, 24 Apr 87 pp 7-8

[Text] For some time scientists have been examining how principles of information processing in biological systems could be used to solve engineering problems. However, the spectacular statements which envisaged a biocomputer now have been examined more seriously. The recently compiled project of the Federal Ministry for Research and Technology [BMFT] regarding basic research in information technology explicitly mentions in several places the importance of biological information processing research as a preliminary approach to future information technology.

Within the framework of new tasks for the nuclear research installation in Juelich (KFA), the former Institute for Neurobiology is being renamed the "Institute for Biological Information Processing" (IBI). It will conduct research in the area of information processing in biological systems.

Based on previous work done at the institute regarding signal reception and signal transformation in photoreceptor cells, future research projects will be increasingly concerned with the explanation of secondary processes in cells, particularly signal amplification, signal transmission and integration, and adaptation and adjustment of cell-specific rhythmic activities. These problems will be researched in simple and easily accessible experimental objects, such as bacteria or cells which are specialized for one function only.

The capabilities of the human brain are among the most mysterious in nature, and science is still far from understanding them. At present, neurobiology offers the promising prospect of reaching conclusions regarding the functioning of neural circuits from the analysis of relatively simple neural networks in snails and crayfish.

Another approach to the use of biological mechanisms is through the analysis of signal paths in the cell. Receptor molecules from sensory cells can be combined with semiconductor elements to form artificial "sensors" which can be used for medical diagnostics and the control of foodstuffs. The change of state in certain proteins between two conformations is being discussed as a possibility for a "molecular switch." Interacting enzymes also may be used as building blocks in "bioelectronics." The basic research at IBI could make such future applications possible.

8617

CSO: 3698/M269

## FRANCE'S 'OASIS': COMPUTER-AIDED MOLECULE DESIGN

Paris INTELLIGENCE ARTIFICIEL in French Apr 87 pp 7-8

[Excerpts] Various systems of computer-aided organic synthesis have made their appearance, or are in the course of development, particularly in the United States and France. A team of the CRIN [Data Processing Research Center at Nancy], headed by J.-P. Haton, has devoted its efforts to this type of development under the OASIS project, which is to be the subject of a presentation at COGNITIVA 87.

Begun in 1985-86, the OASIS project is targeted to aid the experienced chemist in the design of organic molecules. The system is further intended as a tool to aid in the development of an Interactive System of Synthesis. Conceivably, a specialized software for the chemistry of silicon could be constructed progressively in the same manner, without any modification having to be made to the system's general architecture. Practically speaking, the Nancy team envisions a system constructed incrementally, starting with a basic kernel possessing knowledge of the chemical fundamentals (electrons, atoms, molecules, reactional mechanisms, etc...) To satisfy the needs of the expert chemist, the system will have to be capable of operating in one of the three following modes:

1. Retrosynthesis (research on starting-reagents and on synthetic processes for manufacturing a target-molecule);
2. Synthesis (research on synthetic processes for manufacturing a target-molecule when the starting-reagents are already known);
3. Research on the result, unknown at the outset, of the bringing into play of several reagents.

Interactivity with the specialist using the tool is accorded a major role.

The system is centered on a problem-solving manager, the function of which is to control the calling up of specialized modules to bear on the problem, basing its action on the use of expert strategies. In particular, these modules include a resolver of chemical equations (the reactor) operating in conjunction with a base of expert rules and mechanisms. This base is essentially self-enlarging through the action of a learner. In the operation of the

reactor, it was decided not to refer systematically to a library of proven "historical" reactions, the intent being to keep it open to possible new approaches as yet unexplored.

The learner module is designed to go into operation whenever the system is used. It is triggered by every remark made by the expert chemist on synthesis during a consultation. The Nancy team, in addition to defining the general architecture of the Oasis system, has devoted effort to the problem of the representation of knowledge and to the "learner" module. The latter two points will be the subjects of a more detailed presentation at COGNITIVA 87.

An initial rough draft of OASIS, to be used for validating the choices made, was written in the INRIA's [National Institute for Data Processing and Automation Research] CEYX programming language for the VAX-Unix system. The system is presently capable of recognizing some ten functional groups, including the cyclic structures. It incorporates, in the form of rules, a number of reactional mechanisms, and, procedurally, the detection of sensitive zones or the add-on of properties to the object.

Given the functionality of the INRIA's Le-Lisp 15.2 version as compared to previous versions, the work is to be continued in this language and on a workstation of the SUN type. As of now, a procedure for constructing diagrams makes it possible to provide the chemist, at a workstation equipped with a bit-mapping screen, a useful visual representation of the molecule or atom groupings being analyzed.

9238

CSO: 3698/506

## BRIEFS

DFG GENETIC ENGINEERING POLICY--The German Research Society (DFG) maintains that strictly controlled research on human embryos is imperative. This position was given in an official comment on the proposed embryo protection law presented by Justice Minister Hans Engelhard (FDP). DFG President Prof Hubert Markl spoke out in favor of allowing exceptions to this law's general prohibition of the deliberate creation of embryos for research purposes. A DFG statement said that the question of whether it is ethically justifiable to produce human embryos with the objective of obtaining insights through experiments on them in a state of guaranteed painlessness "certainly requires a difficult ethical and legal consideration of the benefits." In the opinion of qualified experts, [the experiments] might make it possible to spare many human beings severe suffering in the future. The DFG supports the position of the federal association of medical doctors which has created a central commission for authorization of this type of research. In addition to biologists and medical doctors, the commission also includes representatives of the ethical sciences as well as public authorities and lawyers. The "comprehensive application of the penal law" for the protection of embryos as envisaged by Engelhard's proposed draft also is considered excessive by the DFG. In view of the fact that every year more than 200,000 healthy fetuses are aborted with no penalty under the hardship provision of paragraph 218, the threat of imprisonment for 3 to 5 years appears to be excessive. [Text] [Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 454, 24 Apr 87, p 7] 8617

CSO: 3698/M268

## ACTIVITIES OF FRENCH AI, ROBOTICS COMPANIES DESCRIBED

## Toulouse EDIA Company

Paris ZERO UN INFORMATIQUE in French 16 Mar 87 p 8

[Article by Anne-Marie Veziat: "EDIA: A Toulouse Company Aims at the International Market"; first paragraph is ZERO UN INFORMATIQUE introduction]

[Text] EDIA (European Artificial Intelligence Company) was created in Toulouse in November 1986. Collaboration with research laboratories, national and also international ambitions: These are the goals of this Decision International subsidiary.

Starting from the premise that Toulouse possesses major research potential in artificial intelligence [AI] but lacks a link to the industrial sector, a local company called Decision International, established at the beginning of 1985, has set up EDIA.

EDIA is capitalized at Fr 500,000, held 50 percent by its founding directors, 20 percent by the Midi-Pyrenees Regional Institute for Industrial Development, and 30 percent by Decision International.

The new company provides application services for expert systems. It also markets two kinds of products: expert system generators such as Nexpert by Neuron Data, Guru by MDBS, and KEE by Intellicorp, as well as its own products and those resulting from joint efforts.

The latter activity has led to the establishment of an ambitious R&D program, with a Fr 1-million annual budget and the support of ANVAR [National Agency for the Implementation of Research].

## Participation in ESPRIT and EUREKA

Three types of products are being developed within the framework of this plan: an expert system for documentary research, a diagnostic aid expert system and tools which aid the development of expert systems. For the present, EDIA's objective is to establish an international AI company in Toulouse by



participating in the European ESPRIT and EUREKA programs. It is already working with companies like Matra and Aerospatiale on design support [CAD] systems.

Its secondline of development, which is to provide an industrial bridge between research centers and companies in various economic sectors, has begun with a cooperation agreement with the Automation and Systems Analysis Laboratory (LAAS) of Toulouse. This agreement concerns a product for troubleshooting perfected by LAAS.

EDIA's staff, currently nine people, should grow to around 40 by 1990, when sales are expected to reach Fr 30 million based on an R&D investment of Fr 3 million.

As with Decision International, which opened an office in Los Angeles in 1986, Jean-Claude Periver, chief executive officer of EDIA and general director of Decision International, plans to set up operations abroad as well as in France (Grenoble by late 1987, Aix-Marseille in 1988). Initially, in all likelihood this year, it will open in Barcelona and Madrid in Spain, to be followed later by Italy, Switzerland and the United States.

#### ACIA: AI Architecture, Circuits

Paris ZERO UN INFORMATIQUE in French 16 Mar 87 pp 36-38

[Article by Daniele Dromard: "New VLSI Circuits: Microprocessors for AI"]

[Excerpts] Some 10 years ago, minis had inferior processing capabilities compared to today's micros and were considered well equipped if they had a 16- or 32-K memory. Nowadays, a PC user wonders how he can work if this PC has "only" 256 K. Can similar sensational improvements be expected in the near future? Many users are wondering.

It is impossible to give a definitive answer, but an idea can be provided by looking at ongoing research in VLSI circuit design and computer architecture for AI. These areas are focal points for the staff of ACIA [Architecture and Circuits for Artificial Intelligence] (see box). As its name indicates, ACIA is seeking to design the VLSI circuits which will be the heart of fifth-generation machines.

There is currently a growing demand for AI products and techniques. However, this field computing power requirements are much greater than current computer capacity. Architectural solutions must therefore be found that can respond to this constant demand for processing power. In this area research is roughly pursuing two major lines:

- improvement of Von Neumann machines increasing parallelism, vectorization, "pipelines," etc.;
- research in alternative architectures and fifth-generation machines, where Japanese research is the best known example.

ACIA is focusing its research on four major areas: design of new VLSI circuits, technologies and circuitry modeling, design and building of CAD software for integrated circuits and structuring knowledge by building an expert system for integrated circuits.

To deal with the complexity of new integrated circuit design, research is developing increasingly sophisticated tools: CAD software for integrated circuits, for example. ACIA is using this to develop an expert system for integrated circuit design. The results obtained for the different types of circuitry and technology are now being formalized by the creation of a knowledge base. This involves:

- defining input rules for elementary logic operators that generate complex logic operators;
- creating a knowledge base to develop simple logic operators in different technologies, according to the circuit type;
- performance evaluation (speed, power loss-surface).

Software written in Prolog is being developed as a tool to aid in choosing a technology and circuit type for different applications.

The ACIA team is thus focusing on specific points where its competence is recognized. It has two main goals: The first is to use its competence in VLSI circuit design (through chip development and testing) to try out original architectural concepts.

Thanks to the experience with integrated circuits, research on the database processor Rapid and on inference engine architectures could culminate in VLSI circuits, which will be the building blocks for new architectures of the so-called fifth generation. These studies were begun recently and will be developed in the coming years.

The second goal is to structure knowledge of circuit design by building a "knowledge base" and also by designing, building and using CAD-VLSI software based on AID techniques.

[Box, p 36]

#### ACIA Team in Brief

The ACIA team belongs to the MASI [Methodology and Architecture for Data Processing Systems] laboratory, a unit associated with CNRS [National Center for Scientific Research] (UA No 818). This research team is composed mainly of doctoral candidates and research lecturers at the Pierre and Marie Curie University (Paris-VI).

Created at the end of 1985 and operating under the direction of Daniel Etiemble, it conducts research on fifth-generation machines. ACIA is relying on recent and foreseeable developments in VLSI circuits. The team's main areas of research are:

- Modeling of VLSI technologies and circuits, and of the corresponding CAD tools, under the direction of Daniel Etiemble;
- processor architecture for building inference engines, under the direction of Quang Hong Hoang;
- language machine architecture, under the direction of Francois Dromard.

ACIA is working with other MASI teams and other laboratories including university (LITP), company (Thomson) and public (CNET [National Center for Telecommunications Studies] Bagneux, INRIA [National Institute for Research on Data Processing and Automation]) facilities. ACIA is located on the Jussieu campus.

LAAS: Automation, Systems Analysis Lab

Paris ZERO UN INFORMATIQUE in French 16 Mar 87 pp 45-46

[Article by Jean-Paul Laumond: "Third-Generation Robotics"; first paragraph is ZERO UN INFORMATIQUE introduction]

[Text] Third-generation robotics is studying highly flexible systems which can operate in different environments. These robots, equipped with vision systems to evaluate their environment, can adjust their actions depending on the context. Even more concisely stated, they are "an intelligent link between perception and action."

Third-generation robotics is a major concern of the robotics and AI research group of CNRS's Laboratory for Automation and Systems Analysis (LAAS), located at Toulouse. Staffed by some 30 researchers and research engineers under Georges Giralt, last year this group celebrated the 10th anniversary of its current structure. A forerunner in this area, it is the spin-off of an earlier group which dealt with robotics in the early 1970's (see box).

The introduction of assembly robots in industry primarily aims at small- and medium-scale batch production in which, for productivity reasons, it is preferable to avoid using complex machines to manufacture a single product. This introduction is made possible by designing production units with manipulator robots, various vision systems (cameras for identifying and locating objects, presence detectors, work effort sensors, etc.) and robot peripherals such as conveyor belts, vises, specialized machinery, etc. The robots are here considered to be components of an integrated "intelligent" system responsible for handling diverse assembly tasks. This concept of the manufacturing robot is based on the Flexible Assembly Unit, developed within the framework of the ARA [Advanced Automation and Robotics] program in 1981.

The themes addressed in this framework (at LAAS) touch upon various control aspects: adjustable control for large movements, force control for manipulating objects in contact, active conformity study for controlling

contact relations, etc. Geometric and spatial reasoning covers the three basic assembly operations: pick-up, transport and assembly. The study of automated trajectory generation is a principal concern.

With a well-structured unit as environment, these problems can be resolved by relying on powerful CAD tools. The decision-related aspects concern developing a system to assist the programming and control of movements. Planning is based on functional modeling of the unit, and the resulting plan is accompanied by an execution model which allows diagnosis and correction of any errors or malfunctions. Finally, this problem-solving process heavily depends on instrument development (computers, robot peripherals, sensors).

Mobile intervention robots have been the object of growing economic interest since the beginning of the decade (although research began at the end of the 1960's). Planned applications include industrial cleaning, conveyance in automated factories, operations in demanding environments (clean rooms, mines, deep-sea depths, nuclear reactors) as well as in agriculture and in the building and defense sectors.

Contrary to assembly robots, mobile intervention robots operate in a loosely-structured or even completely unstructured environment, which explains the importance and difficulty of designing general knowledge representation models. Hilare, born in 1977, is the mobile intervention robot prototype. Moreover, it constitutes the perfect example of the "intelligent machine" for the researcher (see box).

Manipulator robot control is developing in two directions: large movement control and force control for assembly tasks. In the area of large movements, LAAS' activity is focused on geometric, kinematic and dynamic modeling of manipulators and on the identification of inertial mass parameters used in these models.

Elsewhere, results have been obtained in the area of adaptive control of free movement. The originality lies in the modular control structure of manipulators equipped with continuous-current motors and in the preference given to mobile models over trajectory models.

Force control serves to control contact relations between objects in assembly tasks. The difficulty arises from deviations due to imprecisions between the geometric models of manipulated pieces and physical reality. Use of a work effort sensor in the gripper compensates for these imprecisions by allowing a reversal of the control instruction.

In the area of perception, vision plays a central role. Significant image processing systems are being developed to support partially observed object identification and location modules. Three-dimensional modeling of an environment integrates an approach through stereovision defining powerful algorithms for stereocorrespondence, relative position identification, etc.) with continuous vision (visual characteristics tracking).

The goal is to provide vision for autonomous mobile robots, which implies the ability to understand an unknown three-dimensional universe, to build models and to identify known objects.

Because a robot moves an object through space, geometric and spatial reasoning is an important research element. This requires a variety of tools for automated trajectory generation both for mobile and manipulator robots. The main concern is to master the complex interrelationships of algorithms. The addition of symbolic data (functional, topological, semantic) to purely geometric models permits greater control of this complexity. Manipulating these models requires both improving CAD tools used for designing manufacturing robots and creating training techniques for loosely-structured environments.

Inference algorithms are particularly difficult to apply to third-generation robots. The power of expression or such tools as the production control systems are quite adequate for decision process modeling (e.g., task execution control) but real-time constraints still constitute a major problem for the efficiency of these tools.

It is interesting to note that database compilation techniques are being developing within this framework which, beyond their use in robotics, also improve the efficiency of expert systems whenever inference speed is a dominant factor in decisionmaking (failure diagnostic systems, for example).

Compilation techniques are also being studied to produce interpretation structures adapted to host machine architectures. LAAS has just begun to study on the MAIA [Machine for AI Applications] machine in conjunction with CNET.

A second aspect of this "difficult" phase of AI concerns the general approach of real-time knowledge-based systems, which include, for example, mobile intervention robots and surveillance systems (airports). These projects are based on multisensorial perception, which they must integrate while providing real-time signal interpretation, coordination of diversified flows of data, planning, and the management and control of resources. In other words, they bring together the major themes of third-generation robotics.

[Box, p 45]

#### Hilare Robot

Hilare primarily concentrates on vision and decisionmaking. Control does not pose any particular difficulties, as the vehicle is propelled by wheels (which is to the case of walking robots studied by other laboratories).

For distribution both functions adopt the same approach. Distribution of perception means that although vision is essential for constructing three-dimensional geometric models, it is not the robot's only means of acquiring information about its environment. Numerous sensors (proximity

detectors, telemeters, odometers) employing different technologies (laser, ultrasound, infrared) are used to supply diversified and complimentary information, even if occasionally contradictory.

Decisionmaking, for its part, is distributed in modules specializing in resolving problems such as navigation, scene analysis, generation of action plans, etc. All these modules use common resources in the robot and communicate with each other to define, execute and control the actions necessary to complete a task.

The study of the decisionmaking structure is a central research theme, to which action plan generation, real-time decisionmaking control, geometric and spatial reasoning, navigation and training have been added.

[Box, p 46]

#### Robotics at CNRS' LAAS

At LAAS, the robotics and AI research group is studying the three functions of perception, decision and action. The "Environment Perception and Modeling" operation deals with the multiple aspects of vision (from object recognition to the construction of models of a mobile robot's environment) and of multisensorial perception. The "Artificial Intelligence" operation is studying tools for developing knowledge based systems (inference engine, formal knowledge representation models, database compilation, etc.) As for the "Modeling and Control of Movements/Manipulation" operation, it gives priority to the combined use of automation and data processing techniques for defining manipulator command systems.

Of course the robots themselves must be added to these three thematic operations, or more precisely the robot system, which are really integrated systems serving as a base for thought, experimentation and validation. This involves the Hilare mobile robot and the Flexible Assembly Unit. These are the two projects that bring the group together and which are also open to other laboratories outside the group.

Finally, the "Intelligent Machine" technical operation is strongly tied to the AI theme and studies the hardware aspect of symbolic processing.

The closely-knit structure of the group underscores the constant concern with validation and integration. This concern leads to transfer and implementation in industry. This happened with a contour extractor, part of the Visiomat system, marketed by Matra Robotronics and developed in collaboration with other LAAS groups. Transfer also happened with SIAD [Interactive Decision Aiding System], an on-board expert system developed for Alsthom/CGE [General Electricity Company]. It is also the case of an arrangement with Aerospatiale for the automated riveting assembly of fuselage structures.

These three examples illustrate the three thematic operations but do not provide a complete list. Actions involving the two integrated projects must be added to the list. Examples include the current development, in

cooperation with Midi-Robots, of a mobile service robot for use in IBM's factories, and a contract with the same company concerning assembly of electronic components on cards.

It should be noted that along with these initiatives the group is expanding to the outside. In France, the Flexible Assembly Unit has provided experimental support to several teams of the ARA [Automation and Advanced Robotics] program. At the national level the group is participating in the Factory Automation/Robotics cost program [European Cooperation of Scientific and Technical Research], in the Promip (Productique Midi-Pyrenees) group and in the CNRS' PRC-Grec AI group.

Cooperation is being increasingly extended, both within the European framework--through ESPRIT (Skids project) and EUREKA (Prometheus, AMR and Famos projects)--and, beyond that, with research exchanges, mostly with American laboratories (Stanford, SRI, Berkeley, MIT, Philadelphia, etc.) but also with the Japanese and Brazilians.

With this willing openness goes the equally important task of training through research, both in the University and within organizations such as FIRTECH-FIRMIP [Engineer Training through Research in Spreading Technologies].

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## BRIEFS

'BRAIN' ARTIFICIAL INTELLIGENCE PROJECT--In May, the European Economic Community Commission's General Directorate No. 12, in charge of industrial affairs, will launch a program designated "BRAIN" [Basic Research in Adaptive Intelligence and Neurocomputing] designed to subsidize European research in the cognitive sciences and advanced data processing. With an overall budgetary appropriation of 2 million ECUS (and not 20 million ECUS as was originally announced erroneously), the BRAIN program is still in the definitional stage. To define the new program's objectives, DG 12 has formed a committee of six experts from the Community's different member countries. This committee is to report its conclusions by the beginning of May. However, it is already certain as of now that the BRAIN program will be made a part of the STIMULATION ACTION PROGRAMME, which will simplify for it considerably the procedures involved in obtaining Community funds. Thus this program will be able to fund certain projects to the extent of 100 percent, subsidize R&D projects lacking any evident end-use, and support the teaming-up of European university laboratories. [Text] [Paris INTELLIGENCE ARTIFICIELLE in French Apr 87 pp 13-14] 9238

NEW FRENCH AI SOFTWARE FIRM--The INRIA [National Institute for Research in Data Processing and Automation] has formed a subsidiary, ILOG, to develop the applicative potential of the Institute's research in the field of software intelligence. Three years after the founding of Simulog, its first subsidiary, whose activities cover scientific computation, production systems, and the modeling of data processing systems, this second subsidiary will cover the domains situated at the intersection of software engineering and artificial intelligence deriving from software intelligence. With a capital of 1.5 million francs, ILOG's short-term plans call for offering products and services in four distinct domains: 1) LISP Language: Consultative advice on Le Lisp version 15.2 system sharing; development and distribution of graphics environments for the development of applications; development of an implementation based on the future ISO Lisp standard; 2) Software Intelligence Development Tools: Development and diffusion of a gamut of software based on rules and objects, including Classic and Smeci; 3) Consultative advice for the design of specialized systems, using the foregoing tools as aids; and 4) Training in these techniques, languages, and tools. [Text] [Paris ELECTRONIQUE ACTUALITES in French 15 May 87 p 4] 9238

FRG DATA PROCESSING CENTER--The Research Center for Data Processing (FZI) is an institution devoted to extending the limits of technical innovation in computer science for industrial applications. The center's main professional activities involve developing and supplementing the results of computer



research for applications in technical products and industrial production techniques and introducing and testing them in practical applications in close cooperation with industry. In this connection, the FZI is active in the following areas:

--CAD/CAM technology,

--database systems,

--performance analysis of computer systems, data communications,

--microelectronics,

--microprocessors for engineering applications,

--computer aided automation systems

--software technology,

--technical expert systems and robotics. FZI projects range from preliminary studies in processing and product technology and the manufacture of system prototypes to analysis and evaluation of existing products and processes. For projects involving high technical risk, the FZI tries to obtain public subsidies. In addition, the institute offers seminars, consultation and research reports and helps to arrange contacts with affiliated research organizations. At present, the FZI performs its activities with 8 professors and more than 50 employees, including 40 who are computer, electrotechnical, or engineering scientists. [Summary] [Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 453, 10 Apr 87, p 9] 8617

CSO: 3698/M256

NEW JAPANESE AMADA PLANT IN FRANCE, TECHNICAL CENTER IN FRG

Amada Technical Center

Duesseldorf HANDELSBLATT in German 25 May 87 p 1

[Article by "ga": "Nearer to the Customers"]

[Text] Tokyo, 23/24 May--The Amada Company, the leading Japanese manufacturer of metal-working machinery, is placing its hopes in a division of operations within this group on an international scale so as to make it unnecessary to expand further its exports from Japan. As company head Mitsuaki Amada explained to the HANDELSBLATT, within the framework of this concept even the delivery of machinery from the production centers in foreign countries to Japan should then be possible.

This year, the dominant focus of its commitment in Europe is the commencement of production of punch presses in France. The entire European market is to be supplied from this site. For the time being a production outfit in Germany is not being considered. Instead, the sales center in the FRG is to be expanded into a technical center.

Punch-press Production in France

Duesseldorf HANDELSBLATT in German 25 May 87 p 13

[Article by Andreas Gandow: "New Punch Press Production in France"]

[Text] "This year, the commencement of production of punch machines in France is the focus of our commitment in Europe," declares Mitsuaki Amada, president of the Amada Company, the leading Japanese manufacturer of metal processing machinery. Back in in the 1970's this company began on the establishment of a worldwide network of centers for sales, production, and development. In Germany, the sales center is to be expanded into a technical center.

In 1951, Mitsuaki Amada (born in 1932) joined as a 19-year-old the company that was founded by his brother Isamu after the end of the war. The original business of this company was the repairing of machinery. Amada has been a member of the management since 1963, and since 1983 he has headed the group of firms as the chief executive (president).

In the mid-1950's the company then itself undertook the production of band saw machinery and metal working machinery. Moreover Amada developed an independent organizational and marketing philosophy, which allowed for the first time the expansion of the company and made the group as a whole into the leading manufacturer of metal processing machinery in Japan.

For this company, fiscal year 1986/87 (31 March) was marked by a distinct worsening in sales and profits, because of the extreme upward evaluation of the yen and investment weakness in important customer sectors such as the automobile and electrical industry. While sales declined by just under 17 percent to 97.2 billion yen (about DM 1.2 billion), and export proceeds declined by 14 percent to 20.2 billion yen (about DM 250 million), there was a halving of the ordinary earnings (profit before extraordinary returns and taxes) to merely 7.9 billion yen (about DM 95 million). Just in the previous fiscal year a decline in earnings of just under 20 percent had to be absorbed.

However, in this connection Mitsuaki Amada points to the important contribution made by the division of sheet-metal working machinery, where the decline in sales of only just under 10 percent was below average, since the company is profiting from the healthy demand in domestic building construction; in exports it even proved possible to achieve a definite plus amounting to a good 7 percent.

A distinguishing feature of the organization of the group, which now includes 20 Japanese and 17 non-Japanese firms, is its operating in separate product-specific and function-specific business units: The production and selling of the various machines and systems as well as the computers for controlling the manufacturing process and the programs required for these are located in independent firms each time. This applies also to the production firms of Sonoike and Wasino.

However, the Amada Company Ltd in Ishida that functions as the holding company of the Amada group is centrally responsible for the overall research and development activities. Thus, under its direct control is the Central Research Institute and the Material Research Institute of the group, in which working teams composed of employees from individual group firms are always formed for separate projects having fixed deadlines.

Mitsuaki Amada mentions three reasons for this organizational structure: On the one hand, it has been possible to adapt the working conditions and salary structures in the separate units flexibly to the respective requirements. Moreover, the decentralized organization permits a more flexible giving of attention to market developments. But finally, the creation of separate but also interrelating firms leads to a business awareness in the respective management that would not be brought about if it merely functioned as a factory management in a large enterprise. This structure has proved its worth especially in the implementation of rationalization projects, Amada emphasizes.

## Consultation, Material Testing Runs

Central to the marketing conception of the group is the so-called "Amada Industrial Machinery Plaza," as a forum for dialogue with customers and interested parties. On an exhibition area of just under 10,000 square meters, which is open 3 days out of the week including Saturday, about 200 different types of machinery of the group firms are presented. Here, interested parties can be given advice and at the same time can carry out test runs with their own material in order to determine, in talking with technicians of the company, the set of machines or the system suitable for their needs, inclusive of the requisite control units and programs. Therefore Amada views the plaza not merely as a sales site but also as a front line of the development activities of the group, with institutionalized feedback to product development. Finally, this center is complemented by its own education and training facility for technicians of the customer firms.

Moreover, in addition to a sales organization the company has established its own production facilities in the United States and Europe. In the United States, numerically controlled turret presses inclusive of the tools required for these are being manufactured, as well as laser cutting machines. In Europe, the Amada U.K., Ltd. is the location for the production of tools for CNC turret punch presses and the Amada Italia S.r.L. is the location for the production of bands for band-saw machines.

Moreover, in June the production of numerically controlled punch presses for the entire European market is to now begin at the Amada Works in France. Mitsuaki Amada stresses on this point that this will be a purely European production that will take the place of exports from Japan, since also the components and the control units will be obtained from other production centers of the group in Austria and Italy. To this end, the Japanese company had completely taken over the firm of Promecam Sisson Lehman S.A. (now: Amada S.A.) at the end of last year.

According to Mitsuaki Amada, the sales center in the FRG at the Amada GmbH, Haan, is to gradually be expanded into a technical center, in which potential customers can have tests run and where the requisite training for the future technical personnel of the customers can be carried out. But Amada declares that a production site in the FRG is not under consideration at present.

These activities are being supported by centers for research and development work in America and Europe: In the United States, since the beginning of the 1980's at the Amada Engineering & Service Co., Inc., and in Europe since 1985 at the Prima Industrie S.p.A., in which the Japanese company holds a share of 49 percent. Initial results of this Japanese-Italian cooperation are on hand, and it has already proved possible to integrate these results into systems of the company, declares Mitsuaki Amada.

## Division of Operations Instead of Exports

In addition to this direct international commitment, there is technical and sales-related cooperation with Brown & Sharpe Mfg. Co. (United States) in connection with surface grinding machines, with Digital Electronic Automation

(Italy) in three-dimensional mensuration engineering, and with Charmilles Technologies S.A. (Switzerland) in electronic discharging machines.

This international division of labor within the group is to be expanded in the future, so that thereupon even the delivery of machines from the foreign production centers to Japan will be possible: "A further expansion of exports from Japan is not our aim," stresses Amada.

But the forecast of the company is that the decline in sales of the two previous years will continue also in the current fiscal year of 1987/88. At the end of March, the order backlog of 12.4 billion yen was a good 13 percent below the corresponding value of the preceding year. For the entire fiscal year the company is now anticipating another sales decline amounting to a good 3 percent, to 94 billion yen.

However, the ordinary earnings should show improvement again by about 10 percent, to a figure of 8.7 billion yens, due to a closer organizational association between the divisions of sales and development. To this end, declares Mitsuaki Amada, at the beginning of this month five business units were formed that are endowed with greater powers for the product lines of band-saw machinery, sheet-metal working machines, sheet-metal working systems, presses, and plastics processing machinery, in which a close intermeshing of the design engineers in the sales activity is to be done for the purposes of strengthening the company's market position.

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## BRIEFS

EUREKA FLEXIBLE AUTOMATION STUDY--In many areas of industrial production, assembly costs are between 20 to 50 percent of manufacturing expenses and are increasing. However, the degree of assembly automation is still low and therefore represents the area with the highest modernization potential in industrial production. In order to create a sound basis for information and decisionmaking, a preliminary study was started in mid-1986 regarding the possibilities of European cooperation in the area of flexible automated assembly systems. This preliminary study was concerned with the following topics:

- assembly tasks and related problems during the next decade;
- necessary developments (hardware and software);
- goals of cooperative projects;
- proposals for potential projects (content, work plan, priorities);
- forms of cooperation;
- organization and management of cooperation;
- estimate of financial needs, proposals for financing. Participants in the preliminary study were the FRG, France, Britain, Italy, Austria, Sweden and Spain. In the FRG, the study is being led by the Fraunhofer Institute for Production Technology and Automation (IPA) under director Prof Dr H.J. Warnecke, Nobelstr. 12, 7000 Stuttgart 80, and project manager Prof Dr R.D. Schraft, tel: 0711/6868200. The results of the preliminary study will be available in the fall of 1987. It is then up to the industrial companies and research institutes--in accordance with EUREKA guidelines--to find European partners and to prepare for and agree upon cooperation for concrete projects. Initial contacts and requests for information in the FRG should be sent to the prime contractor for production engineering, the Karlsruhe Nuclear Research Institute, Director, Dr Stams, P.O. Box 36 40, 7000 Karlsruhe 1, tel: 07247/825280. [Text] [Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 454, 24 Apr 87 pp 10-11] 8617

CSO: 3698/M266

## BRIEFS

SIEMENS-PHILIPS 4-MBIT CHIP--Product design and technological details of the 4-Mbit chip developed jointly by Siemens and Philips were presented at the "size integration" [Groessenintegration] meeting in Baden-Baden. Speaking about the presentation, FRG Research Minister Riesenhuber declared that a decisive step toward the objective of the 4-Mbit memory project--that is, to catch up with the Japanese world leaders in 1988 in the development of highly integrated semiconductor memories--has succeeded with the completion of this chip. The 4-Mbit chip, whose initial development has followed the scheduled complete product planning phase, measures 91 mm and can store 4 million bits, which is roughly equal to the content of 250 typed DIN A-4 standard sheets or the normal edition of a 20-page national newspaper. The project was funded with DM340 million from the Federal Ministry for Research and Technology [BMFT], while the Netherlands Government added DM160 million. The overall costs of the joint program, including production set-up, totals DM3.4 billion. Today's documented level of development is in line with the project planning in terms of time and cost, Riesenhuber said. For this reason, the fall 1988 project deadline for a demonstration continues to be realistic from today's perspective. According to all information about the competition and its spectacular announcements, the FRG will catch up with the leading nations of Japan and the United States. At the beginning of the project, the time lag with respect to the market leaders was about 2 years. A major objective of the project--to shorten this gap--has already been reached today. [Text] [Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 452, 27 Mar 87 p 4] 8702

CSO: 3698/M241

## FRG INSTITUTES CONDUCT COMPETITIVENESS STUDY

Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 455, 13 May 87 pp 7-8

[Excerpts] International competitiveness of the FRG--Under the auspices of the Federal Ministry of Research, the Fraunhofer Institute for System Technology and Innovative Research (ISI, Karlsruhe) and the Lower Saxony Institute for Economic Research (Hanover) have investigated the following questions regarding the international competitiveness of the FRG:

- development of conditions affecting quotations (prices, costs and potential for innovation)
- development of its share of the international market
- structure and development of the results of foreign trade, particularly involving research-intensive products
- estimation of the technological position of the FRG

The results of the investigation included the following:

The position of the FRG with regard to competitive pricing and labor costs is favorable overall. However, our national economy must still undergo a landmark test: The competitive position which has been established with regard to costs must also be shored up in terms of product structure and utilization of resources in such a way that high real income can be achieved.

The significant resources of the FRG, which are also quite well utilized, include its potential in terms of research and training. But the potential for innovation is increasing in other national economies as well and the competition is more wide open. The FRG is particularly active in the relatively large product group sector having average to slightly above average potential for innovation (especially chemical products, vehicles and machine construction). There is no specialization.

The FRG's share of the international market has declined overall in past years. Only in 1985/86 was there again an increase. This declining share was due to decreased demand in the traditional sales markets (especially machine construction, iron and steel industry), lack of a presence in expanding market areas (overseas) and "homemade" factors. While in the 1970's losses in the market share were due largely to changes in product structure, today regional



structural changes and the ability to compete in terms of technology are of primary importance.

Corresponding to the resources which it has at hand, the industrial priorities of the FRG involve goods which require intensive research and training; in this area the trade results are decidedly positive. Interestingly enough, at the level of less technologically intensive branches of the economy in particular, the FRG was able to improve its position slightly (rocks and minerals, fine ceramics, lumber, paper, printing, leather and textiles, food and drink industry); however, there were also improvements in road vehicles, precision mechanics and optics, nuclear fertile and fissile materials, aviation and aeronautics. In all, the look of specialization has evened out, i.e. traditional areas of commerce have lost some importance and new areas which do not yet have a high profile within the FRG have increased in importance.

An international comparison clearly shows that in terms of trade involving technologically intensive goods the FRG and Japan, in contrast to the United States, are not concentrating on selected high technology items but are rather very successfully supplying the international market with a broad assortment of more elevated traditional technologies. Both with respect to high technology and to more elevated traditional technologies, the United States has had to accept a more obvious loss of position than has the FRG. The improved position of Japan--particularly regarding high technology--is impressive.

In the case of high-technology products, the FRG has taken up a very good technological position behind the United States. Corresponding studies of FRG products rate them higher than those of the Japanese. This ranking is a reflection of the intensity of high-technology research. In the case of more elevated traditional technologies, on the other hand, Japanese standards have the lead; American and West German products are rated somewhat lower. In supplementary case studies, the level of technical performance has proved to be a decisive factor in terms of competitiveness involving high technology.

A special study of data on the development of competition in the future by the Donors Association for Promoting German Science showed greater than average increases in research expenditures in certain key areas including electronics, steel construction, machine construction and vehicle construction. Corresponding to a worldwide trend in the mechanical and electrical industries, there are indications of more and more interlinking in R&D which is being referred to as "mechatronics." In all, the FRG economy has undertaken intensive efforts toward adaptation and development in order to ensure its technological competitiveness in the future. Whether this is being done to the same extent as in Japan cannot be said due to gaps in research statistics.

The research results described above were published under the title "Spitzentechnik, Gebrauchstechnik, Innovationspotential und Preise" [High Technology, Traditional Technology, Potential for Innovation and Prices] by Verlag TUEV Rheinland (Cologne).

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## BRIEFS

RIESENHUBER VIEWS EEC BUDGET DISPUTE--On his return from Brussels, Research Minister Heinz Riesenhuber (CDU) directly criticized the research policy of the EC Commission: [he said that] rather than continually proposing new research programs, it is more important to develop common standards and regulations in the field of technology and research. The dispute over whether the new research framework program should include 4 or 8 billion ECU is irrelevant in comparison with the development of a common market. Riesenhuber said that it is deplorable that discussions between research ministers always come back to money instead of being dedicated to urgent issues concerning structural development. The minister pointed out that the FRG obtains, at the most, one-third of one percent of the funds for its research work from the EC, although one-third of all these EC funds is provided by German taxpayers. In addition, the research minister stressed that throughout the EEC there are many bilateral research projects, above all the EUREKA European research cooperation program, which have plenty of cooperation plans. However, he added that Bonn would not stand in the way of a compromise concerning the issue of the new research framework program through 1991, which should be reached by 3 April. [Text] [Bonn TECHNOLOGIE NACHRICHTEN-MANAGEMENT INFORMATIONEN in German No 452, 27 Mar 87 pp 11-12] 8701

CSO: 3698/M245

## HUNGARIAN ACADEMY RESEARCH IN BIOORGANIC CHEMISTRY

Budapest MAGYAR TUDOMANY in Hungarian No 4, Apr 87 pp 319-330

[Article by Laszlo Otvos, doctor of chemical science, deputy director of the Central Chemical Research Institute of the Hungarian Academy of Sciences: "Bioorganic Chemistry Research at Academy Research Sites"]

[Excerpts] Bioorganic chemistry is the most newly created branch of organic chemistry, one developing swiftly internationally although still little known even to readers acquainted with chemistry. In a number of cases such research done in the past 5 years has brought outstanding results. Although the program was aimed at solving basic research tasks a number of the studies directly served the goals of pharmaceutical and crop protection materials development. About ten such products were created in Academy institutes which are being manufactured or introduced.

The present article is intended primarily to give an account of the achievements of bioorganic research done within the framework of the MTA [Hungarian Academy of Sciences] in the past 5 years. To a very significant degree this research was done within the framework of the MTA KKP/1 program titled "Research on the Lawful Relationships of Links Between Chemical Structure and Biological Effect" and to a lesser degree it was done within the framework of a state commission titled "Pharmaceutical and Crop Protection Material Basic Research." All this meant essentially a continuation of the earlier MTA program research, "Research on Biologically Active Compounds," handled as part of the OTTKT [National Long-Range Scientific Research Plan], although substantially narrowed as to theme area and institutional network.

The above thematics were aimed primarily at solving basic research tasks. On the basis of the opinions of various official committees the achievements were significant, in a number of cases outstanding. The publications data (382 articles) are imposing as are the scientometric indexes of the achievements.

Due partly to the theoretical results deriving from the foregoing and partly to methodological developments serving them a foundation was provided so that the MTA institutes and institutions participating in the programs could effectively aid, with the tools of bioorganic chemistry, the applied research being done to solve the OKKFT [National Medium-Range Research and Development Plan] subtasks A/7 ("Development of Original Pharmaceutical Research") and A/8

("Crop Protection Materials Research and Development"). In addition to these enterprise initiated themes a significant role went to original products they discovered themselves of which nine or ten have been or shortly will be manufactured on the basis of bioorganic results alone.

On the basis of all this it is no exaggeration to say that the bioactive research taking place in institutes of the MTA is progressing well and that bioorganic chemistry has a very significant place in them. In what follows we will raise a few general and especially domestic questions concerning bioorganic research, more as situation analysis than for the sake of seeking disturbing problems.

#### Instead of an Introduction

He who undertakes to write an article limited to the theme given in the title, and an article intended not only for the professional directly interested reader, immediately faces a difficult and many-times thankless task.

The difficulty is caused primarily by the fact that bioorganic chemistry is the most newly created branch of organic chemistry and although it is developing swiftly internationally it is still less known even to a reader acquainted with chemistry than the areas which developed earlier. This fact makes unavoidable a description, as terse as possible, of the conceptual sphere of the theme area, unfortunately leaving less space for a description of the achievements.

A number of factors make the task a thankless one. First among these is the fact that bioorganic chemistry is the branch of chemistry lying closest to biochemistry or molecular biology, so much so that the theme areas often overlap even in the international literature. It follows that drawing a boundary line involves very many subjective elements. A subjective delimitation might not only offend individual professional interests pro and con as a result of a selected summary of achievements it can also give cause for a real scientific categorization dilemma. Insofar as this provokes professional scientific debates and aids the many-sided approach to some important problem we should recognize the fact with joy. But insofar as the judgment of the territorial affiliation of the given theme raises problems in connection with support one must certainly decide for a more rational method of approach.

It is also a thankless task to limit the not too broad based domestic bioorganic research to the institutions of the MTA. For example, a very significant proportion of the results achieved in recent years were achieved in research on oligo and polypeptides. Only a part of these came from Academy research sites. Measuring even by international standards very prestigious bioorganic results were achieved at pharmaceutical industry research sites (the Kobanya Pharmaceutical Factory and the Medical Research Institute), and at provincial medical universities--a conformation study of peptides, a study of their enzyme catalyzed transformations, discovery of interdependencies between chemical structure and biological effect, discoveries in the area of their in vitro and in vivo metabolism and synthetic and radiosynthetic research serving these.

The question properly arises that while almost two thirds of the organic and molecular structure research capacity of the Central Chemical Research Institute deals with basic or applied bioorganic themes, why is the influence of bioorganic chemistry so small--with the exception of peptide research--in other MTA institutions? It is only a partially acceptable answer that the research is done in relatively broad cooperation so it finds a response in other places if not in Academy institutions. It is closer to the truth if we say, on the one hand, that a not negligible percentage of the achievements of the MTA KKKI [Central Chemical Research Institute of the Hungarian Academy of Sciences] listed in this theme area are formal, within this of a beginning nature, covering chemical structure-biological effect interdependencies, and that, on the other hand, the orientation toward typically bioorganic themes was caused by the theme forming effect of collateral financial sources (OMFB [National Technical Development Committee] contributions, MTA investment allotments). In essence the above were also characteristic of the research of the SOTE-EKSZ [United Research Organization of the Semmelweis Medical University] and of the MTA KOKI [Experimental Medical Research Institute].

Returning to the problematics of professional categories, permit me to express the conviction that defining the central scientific goal is primary. This poses a task for biochemistry, molecular biology and bioorganic chemistry, to understand ever more precisely and profoundly the chemical bases of biological processes, independent of the domestic disciplinary categorization (chemistry or biology or even medical science). It is also a common goal to serve with these achievements the bioactive industries of Hungary, primarily pharmaceutical and crop protection material manufacture, and the practical needs of domestic agriculture. All this presumes not only the peaceful coexistence of scientific branches but also the necessary dependence of them on one another.

#### The Development, Conceptual Sphere and Links of Bioorganic Chemistry

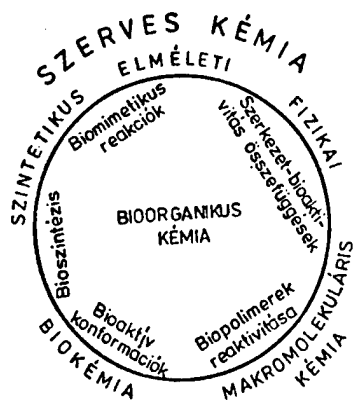
The development of domestic bioorganic research practically coincided with its international creation, as is shown by the early participation in the "Symposium on the Chemistry of Natural Products" programs. It is a domestic characteristic that the biochemistry congresses and conferences and medical biochemistry programs provided room for participation here before the organic chemistry ones did. After formation of the bioorganic chemistry work committee of the MTA the chemical prestige of the branch grew and today it constitutes an integral part of organic chemistry.

#### Research Trends in the Academy Institutes

The publication figures mentioned above show that under the available material conditions bioorganic chemistry basic research has been cultivated very successfully in the past 5 years in the institutions under the authority of the MTA. It is obvious that even listing the achievements and publications by title would exceed many times the extent of the present article. Since the intent of the article is not to inform those working in the area but rather to provide information, to a certain extent popular general information, for a broader professional audience we will illustrate the achievements with a few

selected examples. The grouping shows a certain duality; it was done in part according to the bioorganic chemistry trends shown in Figure 1 and in part according to the theme groups of MTA program KKP/1, which derives primarily from the need to link what is said to concepts already known.

Figure 1. Organic Chemistry Diagram



[The circle with bioorganic chemistry in the center is surrounded by two rings. The outer ring is labeled: Synthetic, Theoretical, Physical, Macromolecular Chemistry and Biochemistry. The inner ring is labeled: Biomimetic reactions, Structure-bioactivity interdependencies, Reactivity of biopolymers, Bioactive conformations and Biosynthesis.]

We have broken the themes into two units.

a. The search for the general interdependencies of chemical structure and bioactivity. In this theme unit we have grouped the research aimed at learning the general lawful relationships between chemical structure and biological effect, or the biotransformation processes (pharmacokinetic and pharmacodynamic) determining the latter.

b. Biorganic research on chemically or effectively related compound groups. The themes listed here are aimed at discovering the connections between the structural parameters of compound groups of key importance (e.g., peptides, oligo and polynucleotides), their biochemical transformation potential and their biological effect. An important element of these studies is that knowing the endogenous metabolic processes provides a guide for synthesis of exogenous materials with related structures which make possible biological influence in a determined, desirable direction (destroying harmful microorganisms, controlling insect populations, increasing the useful yield of plants, etc.).

#### A Few Achievements of Recent Years

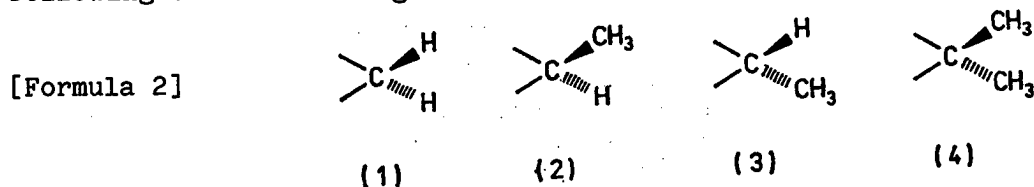
Rationalization of the Empirical Quantitative Structure-Effect Interdependencies (QSAR Method)

Comparative quantitative analysis (QSAR) of the chemical, biochemical and pharmacological properties of a compound series is a very important area for rational pharmaceutical and crop protection material research. The method is

based on the fact that the physical and chemical properties of the same substitutes in different basic frames influence the bioorganic chemistry, biochemistry and biological properties in the same way, as a trend, and the degree of influence can be described quantitatively with various constants. In the case of a larger number of compounds the analysis is done with a computer. Among the factors influencing the properties a special role goes to the steric effect of the substitutes. A number of types of constants have been introduced in the past 25 years for a quantitative description of steric effects, all of them with an empirical base. The aim of the research named in the title was to make the steric constants interdependent with the form of the substitutes, thus giving them concrete physical meaning. In the interaction between a biopolymer (Bp) and a small molecule or substrate (S)



the steric effect appears in two processes. Either it hinders the formation of the BpS complex or compound to an extent depending on the ratio of space filling (a), or it has an effect on the reaction within the BpS complex (b). The so-called "compression steric substitute effect" plays the crucial role in the balance process (a) while the "orientation steric substitute effect" plays the crucial role in the transformation reaction (b). With the two effects not only does the reactivity of the series of substitutes become interpretable but also the stereospecificity which is of crucial significance in biopolymer reactions. The studies generally involve synthesis of quadruple compound groups and a study of their interactions with biomacromolecules, where the following substitutes figure for a given carbon atom.



The reactivity of compounds (2) and (3) is identical or close to that of either compound (1) or (4); there are differences of an order of magnitude between (1) and (4) and accordingly--expressing the stereospecificity--between (2) and (3). Thus one can decide in which optically active isomer the spatial position of the  $-\text{CH}_3$  group within the (BpS) complex corresponds: to the H atom or to the  $-\text{CH}_3$  substitute. The substitutes mentioned are spherically or quasispherically symmetric, thus the effect is quantitative, which can be described with van der Waals radii exactly expressing the physical dimensions of the substitutes. On the basis of the results obtained from the (1), (2), (3) and (4) compound groups it becomes possible to interpret the steric influence of  $\text{R}^1$  and  $\text{R}^2$  substitution in any group.



Using the theory it was possible to interpret the following biopolymerchemical transformations:

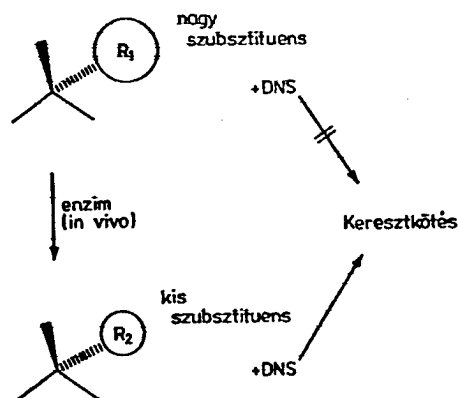
- DNA reactivity in cross-bonding alkylation reactions;
- hydrolase (alpha-chymotrypsin, acylase-I, papain) catalyzed enzyme transformations;
- DNA polymerase catalyzed nucleic acid synthesis building in analog nucleotides; and
- receptor binding processes of diazepines.

The In Vitro and In Vivo Transformation Potential of Esters and Establishing Interdependencies Between Their Pharmacological Effects

Materials entering various living organisms (microorganisms, plants, animals and humans) are constantly subjected to conditions of transformation and a gradually developing neutralization (bioinactivation). In other cases the compounds become effective through bioactivation. Metabolic studies are a necessary requirement for trade in pharmaceuticals and crop protection materials. A theoretical study and discovery of the general lawful relationships of the processes is necessary for these reasons. Influencing the processes has direct practical significance in pharmaceutical chemistry and in designing crop protection materials. The bioactivation process best known up to now and thus one which can be used in pharmacological research is ester hydrolysis catalyzed by specific and aspecific enzymes. The principle is to get an effective material containing a hydroxyl group into the organism in the form of an inactive ester. Such compounds are called pro-drugs. The esterizing acyl group can have extraordinarily wide structural variation, which can fundamentally influence absorption, dispersion and elimination within the living organism. This has advantageous pharmacological properties, beyond extending the effective duration, in cell or organ specificity.

Basic and applied research on pro-drugs takes place in our country in a number of places. A significant role in this was won by the studies in which the acyl group is a macromolecule. The in vitro experiments done with organ homogenates or separated units thereof greatly accelerate the studies and make them evaluatable from the organic chemistry viewpoint.

Figure 2.



[The Hungarian words in the figure are, from top to bottom and left to right: large substitute, enzyme (in vivo), cross-bonding, and small substitute.]



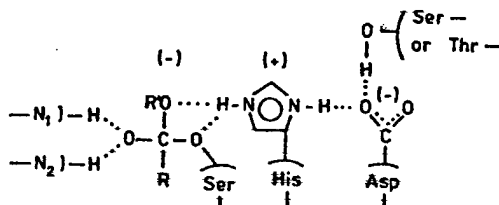
Figure 2 shows, out of many examples, only one case of specificity, which can also be interpreted from the viewpoint of stereochemistry. The bifunctional alkylating agents have their effect by alkylating the DNA, but the tumour specificity, or the interdependent organ specificity, is generally small, which is accompanied by a high degree of toxicity with the doses generally used. If we add a large space filling group to the alkylating agent, which hinders the alkylation of the DNA, then this general toxicity decreases. If the R group is structurally suitable then, through biotransformation, a smaller volume substitute is formed, thus the compound is capable of reacting with the DNA. Organ and cell specificity can be attained in the case of specifically removable protective groups.

#### The Mechanism and Stereochemistry of Reactions Catalyzed by Serine and Thiol-Proteases

The Enzymological Section of the MTA-SZBK [Szeged Biology Center of the Hungarian Academy of Sciences] has done internationally recognized bioorganic research in the area named in the title. In recent years, with detailed knowledge of the spatial structure of serine and thiol proteases, the mechanism and stereochemistry of their transformations have been further refined. The most important of our findings are the following:

The several amino acids form an extensive H-bridge network (Figure 3) at the active site of the "serine proteases"; this network explains the catalytic effect better than any previous theory.

Figure 3.



The most significant difference between the thiol-proteases and the serine-proteases in regard to the mechanism of their functioning lies in the fact that in the case of the former the general base catalysis can be excluded and the role of the oxyanion in the attack on the carbonyl group of the substrate can be ignored.

#### Learning About Crop Protection Material Antidotes Through Bioorganic Chemistry

The two herbicides used in the largest quantities to defend corn, one of our most important cultivated crops, against weeds are a thiocarbamate type EPTC and a chloracetanilide type acetochlorine. But the effective herbicidal doses of them used also harm the corn. To a significant degree the degree of damage (herbicide sensitivity) depends on the type of corn (hybrid, line). Chemical antidotes are compounds which eliminate the harmful effect on the cultivated plant without reducing the ability to destroy weeds.

Discovery of the acid amide type chemical antidotes represents a very nice example of the usefulness of bioorganic chemistry basic research. With a structure dependent systematic study of the compounds mentioned it was possible to establish that the antidote effect was the result of an in vivo acylation reaction. By discovering the structural parameters influencing the acylation potential it became possible to design new antidotes.

#### Discovering the Interdependencies Between the Structure of GnRH Analogs and Their Ovulation Regulating Effect

Production of synthetic analogs of the gonadotropin releasing hormone (GnRH), a biochemical study of them and practical use of them began in the second half of the 1970's and in recent years has been expanded at the No. I Chemical-Biochemical Institute of the MTA-SOTE EKSZ. More than 100 antagonist compounds have been produced by systematic replacement of the amino acids primarily responsible for the biological effect, which was realized through continual bioorganic evaluation and feedback of the structural consequences. As a result of this work it was possible to get a domestically produced compound which is one of the most effective ovulation inhibitors in the world--in the case of continual dosing.

Effective mechanism studies showed that in the case of constant use of superactive analogs of GnRH the reproductive functions are inhibited in a paradoxical manner. On the basis of this it was possible to develop a new type of contraceptive method and to treat in this way various tumours connected with reproductive functions. The metabolic studies established--in contrast to earlier assumptions--that the intact hypophysis cells do not break down the hormone, supporting the idea that the gonadotropic cells of the hypophysis have only one type of GnRH receptor.

#### The Spatial Structure of Branching Chain Polypeptides and Their Complex Generating Characteristics with Pharmacons

The combination of macromolecules with pharmacons (e.g., anticancer agents) can increase selectivity in a number of ways, thus reducing harmful side effects. The carrier can advantageously change the transport properties of the pharmacon, can increase its stability in biological systems and can provide favorable immunological parameters.

By modifying the side chains of poly-lysine they synthesized carriers with various structures in the Peptide Chemistry Research Group of the MTA. In designing these they started from the idea that from the viewpoint of antigenicity or immuno modifying effect--and presumably other biological properties of the molecule--the constitution and conformation of the molecule both play an important role.

They studied the spatial structure of polypeptides with an analysis of CD spectra. They established that the spatial structure depends on the quality, configuration and number of amino acids connected to the poly-lysine spine--acylating the epsilon amino groups.

They studied the ability of polymers to bond to a pharmacoon with a number of tumour inhibiting materials. They got the most easily interpretable results with 1-beta-D-arabinofuranosyl cytozine (Ara-C). The antimetabolic effect of the compound can be potentiated with proteins, thus with macromolecular complexes of the pharmacoon. The reason for this is that the fast metabolism taking place in the organism (Ara-C to Ara-U) is delayed in the macromolecular complex.

#### Research on Bonding Processes Taking Place on Receptors

Of crucial significance from the pharmaceutical research viewpoint is to what biopolymer a given effective agent bonds and with what specificity. In molecular pharmacology research aimed at discovering this a salient role is played by studies of various receptors. Because of their importance more and more research sites are dealing with isolation and characterization of receptors and with a discovery of their pharmacoon bonding properties.

1. The point of attack of substances having a tranquillizing and antispasmodic effect on the central nervous system is the so-called GABA receptor which can be found in the brains of mammals, which regulates brain stimulation transmission or suppression. The biological effect lies in the fact that as a result of bonding on the receptor an ion channel opens in the membrane of the nerve cell, making possible the free flow of chloride ions thus changing the polarization relationships which hinders the spread of the stimulus from one nerve cell to another.

By studying a large number of natural and synthetic alkaloids light was cast on the chemical structural conditions for bonding on the GABA receptor, which is a significant aid to design or synthesis of new effective agents. On the basis of studies done on the surface of living nerve cells they succeeded in characterizing the differences which appear in the properties of a prepared receptor from the brains of experimental animals and of a receptor functioning in a living brain.

2. A study of the bonding processes taking place on various receptors is also of outstanding significance in discovering the interdependencies between the chemical structure of biologically active peptides and their physiological effect.

Using classical methods of peptide synthesis they produced a large number of analogs in the area of neuromodulator encephalines. These included derivatives modified at the N terminal and abbreviated or lengthened at the C terminal. A biological study of the compounds in vitro showed that specificity in the direction of the mu receptors increases in parallel with the nonpolar character of the C terminal.

In recent years significant capacity has been devoted to the synthesis of enkephaline derivatives which contain chemically reactive alkylating groups (e.g. a methyl chloride molecule part). Methyl chloride ketones bond irreversibly to the opiate receptors of a synaptosoma membrane isolated from a rat brain. Use of a tritiated methyl chloride ketone also makes possible a chemical characterization of the receptor.

The above research was done in cooperation by the MTA SZBK and the MTA KKKI.

#### Bioorganic Chemistry Research on Nucleoside and Nucleotide Analogs Having an Antiviral Effect

It is a special characteristic of domestic bioorganic chemistry research that the synthetic chemistry of nucleosides has developed within it. A synthetic and theoretical organic chemistry study of nucleotides is of substantially earlier origin, the work of a research group established at the Szeged Biological Center of the MTA.

The synthetic chemistry of nucleosides was produced by the need to produce model compounds for the bioorganic research which was aimed at an understanding of enzymatic synthesis of nucleic acids containing analogs, the structure of the polymers produced and their further stability. Later the primary goal of these studies became the creation of new chemotherapy, primarily antiviral, materials and developing them into medicines. The above research required a study of the in vitro and in vivo transformation potential of nucleosides as a function of chemical structure.

The biosynthesis and catabolism of nucleic acids consists of a series of enzymatic processes. Substrate analogs are most suitable for selective influence of the several steps of the transformations. The non-natural nucleosides inhibit primarily the polymerization processes and the synthesis of the 5'-phosphates or triphosphates needed to build macromolecules. In recent years more than 300 pyrimidine nucleoside and nucleotide analogs, counting earlier ones as well, have been synthesized to study the lawful relationships of these transformations. Taking into consideration the priority of chemotherapy viewpoints the following enzymatic transformations of the compounds were studied: a. thymidine kinase, b. DNA and RNA polymerase, and c. nucleoside phosphorilase.

Just listing the titles of the studies of the last few years would go far beyond the spatial limits of this article. Just as an illustration of the results we should mention that a detailed analysis of all the above transformations supported the good antiviral effect of 5-isopropyl-2'-desoxyuridine (IPDU). Another example is the study of a large number of 5-alkenyl and 5-haloalkenyl-pyrimidine derivatives. As a result of the studies listed, primarily of enzymatic processes catalyzed by polymerases, it became possible to produce new compounds with an antiviral effect in a planned way.

#### Synthesis of Nucleoside Phosphoamidates and a Study of Their Transformations

The broad research done at the MTA SZBK is primarily of a synthetic and theoretical organic chemistry nature but their discoveries can also be used in biochemistry research. Of the most recent achievements we should mention the synthesis of cyclophosphate amides, a demonstration of the mechanism of their formation and of the structure and spatial structure of the products and the isolation of products in the reaction of P<sup>1</sup>-amino-nucleoside-triphosphates with ribonucleosides in an alkaline water medium, establishing their structure and reaction potential.

On the basis of the above results it became possible to develop a method for production of dinucleotide phosphamidates and to give a critical analysis of results in the literature connected with the stability of tri-ribonucleoside-di-phosphamidates.

#### Practical Achievements

We outlined in the introduction the conceptual sphere and basic goals of bioorganic research. At a number of places there has been a reference to the fact that due to the character of the research the studies directly serve the rational development of medicines and crop protection materials. The result is that bioorganic or biochemistry methods lead much more effectively to the discovery of original agents than do empirical methods (mass production of compounds followed by biological testing). In the past 5-8 years the institutes of the MTA, with relatively small research capacity, have created about ten products which are being introduced in practice or soon will be. These are the following:

Bioactive metabolism research has resulted in two anti-tumour materials, in various clinical study phases, and one tranquilizer.

One representative of the GnRH analogs ("Ovurelin"), used to regulate animal propagation, is being manufactured. A study of two other materials affecting ovulation is well advanced.

Significant results were achieved in practical use of basic bioorganic chemistry research on nucleosides and nucleotides. Two antiherpetic skin and eye medicines ("Hevizos" and "Revidur") have been registered and manufacture of them has been prepared.

Basic research on herbicide antidotes brought outstanding practical results. One compound selected (MG-191) is being sold abroad.

Research on pheromones and juvenoids to control insect populations, research not detailed above, also involved a number of structure-effect studies. The study of compounds connected with inhibition of mevalonic acid biosynthesis included effect mechanism research of a bioorganic character. This includes the synthesis of mevalolacton derivatives and a study of their receptor bonding processes. Manufacture has begun of insect traps using three materials from the pheromone sphere.

Manufacture is being prepared of two original preparations which increase crop yields, developed as a result of research at the MTA Isotope Institute on the basis of a study of how to influence plant carbon dioxide fixation and in vivo nucleic acid, carbohydrate and protein synthesis.

#### A Final Word

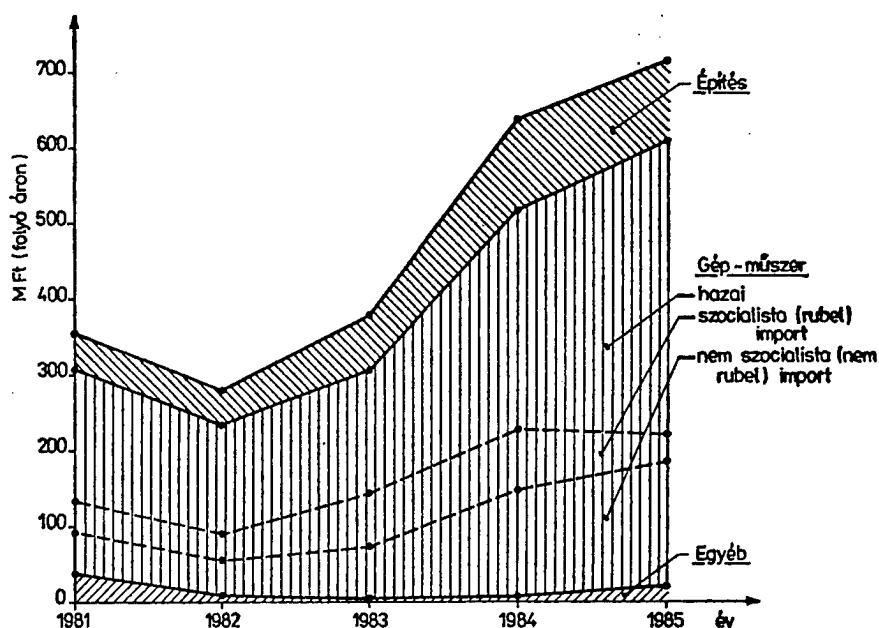
We have tried to provide information about a number of aspects of bioorganic chemistry research taking place within the framework of the MTA, giving only samples of the achievements. Our goal was to thus describe the bioorganic way

of thinking, so we avoided naming the people guiding and participating in the research. Where the name of the institution is not given we are talking about the work of the MTA KKKI.

Nor was it possible to describe the spectroscopic, X ray diffraction, instrument analytic and radiosynthetic research indispensable for bioorganic chemistry studies. Without mass and infrared spectroscopy it would be impossible to study the structure of microgram quantities of materials isolated from biological systems. X ray diffraction provided the first opportunity for determining the spatial structure of biopolymers. The bioorganic use of NMR spectroscopy is extraordinarily broad. This technique is a swiftly developing method for stereochemistry studies of the spatial structure of large molecule materials in solution and of complexes formed by them with small molecules.

The synthesis of radio-isotope compounds is of great importance for biotransformation research and studies of receptor isolation and bonding of receptor and serum proteins. It would be very useful to summarize all these methods in a separate article.

Concluding figure: Material-Technical Composition of the Investments of Academy Research Institutes



[The vertical axis is in millions of forints at current prices. The categories, from top to bottom, are: Construction, Machines and Instruments (Domestic, socialist [ruble] import and non-socialist [non-ruble] import) and Other.]

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## HUNGARIAN ACADEMY OF SCIENCES, BIOTECHNOLOGY PROGRAM

Budapest MAGYAR TUDOMANY in Hungarian No 4, Apr 87 pp 331-337

[Article by Lajos Alföldi, corresponding member of the MTA (Hungarian Academy of Sciences) and director in chief of the Szeged Biological Center of the MTA: "The Domestic Biotechnology Program and the Academy"]

[Text] In 1971, when the Szeged Biological Center began to operate, there was a lively professional debate about what tasks the research staff of the institute would deal with. Should they take up themes the practical importance of which was obvious already or themes with which they might link into the most exciting, timely basic research tasks of the science? They decided for the latter and thanks to this when the biotechnology program came on the agenda a good decade later an experienced and informed expert staff was available for a new trend of extraordinary importance for practice.

One might perhaps put the beginning of the domestic biotechnology program at the time when, at the beginning of 1983, the chairman of the Council of Ministers noted a newspaper article and asked the secretariat of the Science Policy Committee for information about what biotechnology was and why foreign government organs were dealing so much with it. The secretariat of the Science Policy Committee turned to the MTA and a first brief summary of a few pages was prepared about biotechnology and its potential economic importance. Beginning then they began to deal with the question intensively at the most varied government levels--the Science Policy Committee, the OMF [National Technical Development Committee], the National Plan Office, the Ministry of Agriculture and Food and the Ministry of Industry--and various studies and later program proposals were prepared.

In this process the role of the MTA was of key importance in the sense that at that time its research network, and especially the Szeged Biological Center, had been working already for at least a decade on solving the basic research tasks in the course of which they had come in contact with the new trend called biotechnology.

I would like to note at the very beginning that when the word biotechnology appeared at the government level everyone who had some economic contact with some living system or produced something assumed that he was a biotechnologist. And basically this was true. It is extraordinarily difficult

to delimit the special area of biotechnology. Still it can definitely be said that the government level interest in this area did not appear as a result of traditional production processes.

So what was the process then which made the entire question so timely?

When giving an answer one must go back to the development of one branch of experimental biology, so-called molecular biology. What was new in the research trend of molecular biology was that it was trying to solve such fundamental biological questions as genetic information, its replication, the transcribing of information and its translation into the protein "language" by using very complex methodological innovations and an entirely new approach.

This period has been called a new revolution in biology. Obviously this research was of such a profoundly basic research character that it had nothing in common with practical life or the economic sphere. But in the 1960's, with extraordinary foresight, the leadership of the MTA felt that from the viewpoint of the development of Hungarian biological research this trend had to be adopted in our country, and keeping this in mind they decided in December 1962 to create a biological research center.

When this institution began to operate in Szeged in 1971 there was a lively professional debate about what research tasks the research staff of the institution should deal with. It is extraordinarily instructive to look back on this now, 16 years later. Not in order to discover who was right and who was not but rather because it well illustrates what a correct science policy procedure is.

The debate, which took place essentially among experts, can be summed up by asking whether the new institute should take up, with its great capacity, themes the importance of which for practice was unambiguously obvious in 1971 or themes which meant linking into the solution of timely basic research tasks, the economic effect of which might be felt only in the long run. Let us illustrate this dilemma with just one example. Should we continue the basic research with classical methods constituting the basis for an intensive wheat improvement program or, independent of the economic significance of a crop at our disposal, begin somatic plant cell genetic work still then regarded by many as having uncertain prospects?

The leadership of the Academy did not want to decide questions of such and similar significance but rather gave responsibility for the decision to the experts of the institute. But they emphatically said that they expected from the institute brave initiatives and performance at the international level. So in this period what could unambiguously motivate the decision of the researchers of the institution were those areas in which they might link into a solution of the most exciting tasks in that period of the science, tasks which were also interesting for the international field, but about which it was felt then that they could have an economic effect in the long run. So the research groups at Szeged were organized for nucleic acid research, membrane research, in vitro study of plant somatic cell systems, research on photosynthesis, etc. and the enzymological research, already traditional



within Academy frameworks, was continued also. At that time this meant cultivation of molecular biology basic research.

And now we can return to the question of how practical biotechnology came out of this basic research area. It did so because at this time, primarily in the course of nucleic acid research, they achieved in the international field results (e.g., the possibility of cutting the nucleic acid molecules at precisely determined points or the development of a technique for chemical DNA synthesis) which quite unexpectedly foretold the possibility of controlled utilization of living systems. These results created new opportunities for practice as well and drew enterprising industrialists like a magnet.

Let us be modest and admit that we did not play a key role in this area. But the research staff which worked on the solution of tasks they set themselves in the area of nucleic acid research, if they wanted to keep up to the international level in this area, had to learn and apply all the technology created in the meantime and the approach which stood behind it. They were the ones who, at the end of the 1970's and beginning of the 1980's, began to popularize at professional meetings the new possibilities which were also important for practice, possibilities which many practical experts at the time received with fundamental doubts.

Research on plant cell cultures also began as basic research in Szeged in 1971, when the possibilities of this research trend were still very limited. But the prospects seemed all the more promising to forward looking researchers because the international field was not so strong in this period that one could not take up the competition without some hope of success.

The leadership of the Academy, whether it believed in the practical prospects of this research or not, still evaluated the professional level of the work being done here with recognition and, asking also for OMFB support, increasingly supported the work of the Szeged research groups which were working well. So it is not surprising that when the Science Policy Committee turned to the Academy for information in 1983 even the colleagues of the first secretary were already so well acquainted with this area that they were able to compile professionally perfect material virtually without researcher aid.

In my opinion the most essential motifs in the entire process were choosing new basic research tasks which seemed most timely at the moment, the trust given workers in the field, recognition of high level work and further support for performance.

After the theoretical ruminations described in the foregoing I would like in the following to illustrate what has been said, now going into details, in a few concrete areas.

1. In 1971 the Nucleic Acid Research Group of the Biochemistry Institute was concerned with the question of why one gene group, the so-called ribosomal genes (rRNA), functioned in a bacterium cell much, much more intensively than any other gene. After a few methodological innovations, trying to solve this problem, they succeeded in clarifying the gene segment coding bacterial ribosomal RNA and they then began to deal with the transcription of this gene.

They were the first to show in connection with rRNA genes the multi-promoter structure of these genes and were the first to show that their number in *Escherichia coli* was seven. They determined the entire structure of the promoter region of an rRNA gene and with electron microscope and in vitro transcription techniques they related function to structure.

A number of new techniques had to be used to solve the problem--as I pointed out earlier. They had to produce enzymes purely and introduce nucleic acid sequencing methods. So in the course of solving the theoretical problem they got into a situation where they learned all the procedures needed for production of any industrially important protein with genetic engineering techniques. So when, in 1980, the first secretary of the MTA gave them the task of producing a bacterium which carried the gene for human insulin and so could be used in production of insulin this appeared for them not as a scientific problem but rather as a developmental task, which they succeeded in fulfilling after overcoming some major and minor difficulties.

But I would like to emphasize yet again that the insulin work was essentially a by-product of nucleic acid research. What was really new was discovery of the structure of the already mentioned ribosomal gene promoter; the discovery of new, previously unknown and later patented, restriction endonucleases and modification enzymes; and, using the ribosomal promoter, the development of new, so-called expression vectors which may later mean something new for industrial production which can be protected by patent.

2. In vitro experiments with plant cells and plant tissue cultures were not discovered at the Szeged institute either. Such work had traditions in our country even when we began to work in this area here. But what this institution and the research groups working here did offer in this research area nicely demonstrates that a suitable concentration of experts and the effect of various areas on one another can lead to scientific successes of international rank, and as a result to practical achievements as well. The young people who began to deal with plant cell cultures in the Biological Center found themselves in a milieu where the successes of the recent past of molecular genetics, microbial genetics and mammalian cell genetics constituted a subject for debate day after day. So they discovered that their plant cells could be regarded as systems just like those mentioned above, so they approached plant cells and cell cultures with an attitude which characterized very few in the world at this time.

So it was at the Szeged Biological Center that were born the first results in which a plant somatic cell culture was made resistant to a material which was poisonous for it. Plants were regenerated from this cell culture and it was shown that these plants were capable of passing on the new properties to their successors by sexual means. Thus a mutation, a property change, produced in a somatic cell in a test tube is present in every single cell of the new plant, if an entire plant can be regenerated from the cell, in the sexual cells as well, and so can be passed on to successors by sexual means.

Today this result constitutes a basic finding of plant somatic cell genetics.

As quickly as possible after their discovery they began to use at Szeged the protoplast (cells without cell walls) culture and fusion procedures, representing one of the important techniques of the new somatic genetics. Thus it was that they demonstrated in a pioneering way, through somatic hybridization of plant cells, certain possibilities of information transfer between plants which cannot be crossed sexually, and in the recent past they published, for the first time in the world, results which proved the existence of genetic recombination between chloroplasts. As technical by-products of this work there was work which led in our country to the swift development of industrial technologies for virus-free plant production, which played a crucial role in creation of the Meriklon association.

Szeged researchers were the first in our country to use genetic engineering techniques in plant systems; they led in and are perhaps today the only ones capable of doing work which constitutes a part of the plant molecular biology research which is becoming ever more prominent internationally.

3. International rank schools of immunological research (the National Haematology and Blood Transfusion Institute, the ELTE [Lorand Eotvos Science University] Godi Biology Station and Immunology Group, the DOTE [Debrecen Medical Science University] Pathology Institute and others) already operated in Hungary when a small immunogenetics research group was established at Szeged. After trials in several directions they finally began to study the process of differentiation of immunocompetent cells, which seemed definitely to be a problem of a theoretical nature. In the process of differentiation surface markers, molecular structures, characterizing the several developmental phases appear on the surface of the cells. A precise identification of these structures (surface antigens) proved to be a basic condition for the research. So they took note, perhaps the first in our country to do so, of a procedure which made identification of surface antigens much more reliable than procedures used thus far. In the new procedure the surface antigens are identified with the aid of so-called monoclonal antibodies. Monoclonal antibodies can be produced with an entirely new procedure, the so-called hybridoma technique. So in the interest of their research they had to introduce the hybridoma technique, producing the monoclonal antibodies with it.

But it was soon discovered concerning the monoclonal antibodies that they could be used not only for basic research but also to solve a number of other tasks of importance to practice. For example, they proved to be vital diagnostic tools in a number of areas of medical practice and veterinary medicine, in identifying plant diseases of virus origin, in pharmaceutical industry technologies, etc. Production of and trade in monoclonal antibodies became a world-wide business undertaking. So the members of the research group suddenly found themselves in a situation where they practically could not deal with solving their basic research goals because everyone expected them to produce monoclonal antibodies.

4. Every living cell is separated from the outside world by a cell membrane. In a great number of cases one can also find a cell wall, but the membrane is the working structure through which the outside world and the cell communicate. So membrane research counts as an independent area of

experimental biology. It is well known that the structure of membranes varies depending on the temperature. There are organisms the cells of which can change the structure of their membranes depending on the external temperature, while others are incapable of this. This phenomenon is especially striking in the plant world. (Think of the types of plants which stand winter and those which are cold sensitive.) What is the mechanism which cold tolerant plants have and which cold sensitive ones lack? Obviously this is an extraordinarily exciting basic research problem. But this is also a basic research task the practical effect of which is also obvious at first hearing, for if we understood how the membranes regulate the state needed for temperature changes then by intervening in the process we might get defense against cold, frost and heat in plants incapable of this by themselves. So membrane research has figured constantly in the program of the Biological Center since the institution was formed. In accordance with the expectations the new possibilities of this research are illustrated by scientific achievements which won international recognition and by patents in the area of increasing the cold, frost and drought resistance of plants.

In addition to the four concrete examples given above we might list others from the work of the institution which prove that solving a well selected problem carried through in accordance with international standards also offers new opportunities for practice. I would also like to illustrate with these examples that modern biology is a branch of science where results with truly profound economic effect are born as a result of basic research, often in a way which could not be predicted, and this is true in our country too. If someone wants to help practice on the basis of present needs and already known facts he will miss the truly new things.

Recognizing this fact the first secretary of the Academy recommended in 1984 that the Science Policy Committee encourage the development of a situation in which the people at the Biological Center could again deal with truly basic research, and could also develop a "branch operation" where the chief task would be converting the results for practical use. The latter activity is not a lower form of science than basic research, but it is a different speciality which requires different expertise. Thus, with the cooperation of the TPB [Science Policy Committee], the State Development Bank and the Innovation Fund, the Biotechnika Joint Stock Company could be formed in 1985. It is already in active operation on an economic basis as a large industrial development laboratory enjoying the support of the Ministry of Industry.

I mentioned earlier that the leadership of the Academy, seeing the high quality basic research being done at the institute, gave it serious support. But under the difficult economic conditions of the past period the Academy also got into a situation where it wanted to shift a significant part of the work being done in its institutes toward the practical sphere. This thinking led, for example, to the insulin program mentioned above within the framework of which not only did they prepare a bacterium strain with the insulin gene but also achieved a chemical synthesis of the insulin gene. In the course of this they created in our country laboratory level conditions for the professional and industrial application of chemical DNA synthesis.

But we must speak separately of an even more comprehensive program which the first secretary realized with the support of the OMFb--Central Research Program 2 (KKP-2) titled "Biotechnology Research With Special Regard to Gene Technologies." This program started in 1980 and had the goal of aiding a broader spread of genetic engineering and monoclonal antibody production techniques and introducing gene synthesis (chemical DNA synthesis) in the country. The program offered support primarily to university faculties and Academy research institutes in the interest of introducing the new techniques and providing an infrastructure for them.

It may not be too much to quote the following evaluation from the final report prepared in 1986:

"The program accomplished the goal set forth and overfulfilled it in a number of areas. In the area of genetic engineering the groups participating in the program, thanks also to the support of KKP-2, use various genetic molecular methods routinely in their everyday research. Within the framework of the program chemical DNA synthesis got started and reached the international level and hybridoma research was placed on broad foundations. In general the research groups participating in the program did quality basic research, as is also indicated by the fact that they published about their work in prestigious international journals.

"Although the goal of the program was the spread and development of domestic basic research using genetic engineering and hybridoma techniques a number of results were also achieved within the framework of the program which can already be used in domestic biotechnology practice. These include the E. coli expression vector suitable for efficient expression of alien genes, a new synthesis-cloning method suitable for synthetic production of large genes, monoclonal antibodies which can be used in diagnostics, etc. These have either already been handed over to developmental-production sites, are in the process of being handed over, or will be in the near future."

The success of the KKP-2 program doubtless aided in being able to start, in 1983, the A-16 program of the OKKFT [National Medium-Range Research and Development Plan] titled "Research and Development on Biotechnological Procedures and Their Use in Agriculture and Industry", under the guidance of the OMFb. And the A-16 program went on organically into the present G-3 stressed research program of the OKKFT with the above title.

Finally, let me return to a statement I made in the introduction, that the new popularity of biotechnology did not appear as a direct further development of classical production procedures. I wanted to show in a very sketchy way with the arbitrarily selected examples given the role played by the Academy in the domestic adoption of this new biotechnology trend. Naturally this does not detract from the results achieved in other areas of biotechnology broadly interpreted; on the contrary, new procedures and real technologies have been and are being born every day in large scale crop production and animal husbandry and in the pharmaceutical and chemical industry with which the country must keep pace. But it is the role of the Academy, if rationally conceived, to embrace the most promising, most forward looking trends always being born from the basic research results. In my opinion the Academy tried to do this in the past period.

## COMPUTER DEVELOPMENT IN CEMA COUNTRIES REVIEWED

Hamburg DIE ZEIT in German No 15, 3 Apr 87 p 41

[Article by Jay Tuck: "Own Manufacture Instead of Theft--An Ambitious Program Is Designed to Promote the Computer Industry"]

[Ext] Sergei Shchavenkov is a computer specialist without a computer. He writes software for the Soviet Union. At the Moscow electricity works, the 38-year technician who is in charge of 11 younger employees, drafts programs for computer controlled lathes. This is a high priority job in Gorbachev's Russia. His profession makes him a member of the nation's elite. However, the serious looking department head with his stoic expression and Dostoevsky beard shows nothing of this.

His ready-made suit is ill-fitting, his black shoes scuffed. His desk, a poorly designed product of a Moscow furniture factory, leaves no room for his long legs. He sits at it sideways. His large but sparsely furnished office houses not a single computer--only pocket calculators and an obsolete punched card machine. His software lines are painstakingly entered (by pencil) in a bound register and subsequently punched on paper tape. Not until the next morning, when the tape is fed into the lathes, will Shchavenkov find out whether his programs are working properly.

Working conditions at the Moscow electricity works are characteristic for the state of affairs prevailing with respect to high technology in the Soviet economy. This is rather odd when we consider that the USSR employs more scientists and engineers than any other country. It detonated the first hydrogen bomb, sent the first satellite into space and is currently about to score the world record for the longest human sojourn in space. The Soviets are investing 3.9 percent of their gross national product in research and development, 50 percent more than the United States. We are bound to ask ourselves why the Eastern Bloc technicians have failed so miserably with regard to computer technology which sets the rate of growth of the world economy.

## Trouble With the Standard of the Equipment

Modern microprocessors--for long a commonplace here in watches and cars, toasters and telephones--are virtually unknown in the daily life of the USSR. Private telephones are still hand cranked, television sets equipped with obsolete vacuum tubes. To this day some cashiers in Moscow's prestige GUM GUM department store are making cash at night with the help of an ancient abacus. Most Easterners know of the computer age only from the speeches of their leaders. Even the weapons factories for the Red Army are hard put to it to keep up with the latest standard of equipment.

All this is supposed to change. At the CPSU party congress a year ago Mikhail Gorbachev called for "the more dynamic development of those industries that determine scientific-technological progress." An ambitious research program, designed to speed up Eastern Bloc technology in 93 key sectors, was advanced by 18 months.

The reason for the Gorbachev initiative, dubbed "Complex Program 2000," is the inconvenient dependence on the West with regard to computers-- increasingly evident in recent years. By now almost everything involving microchips and megabytes in Moscow depends on Western developments. The Russian Ryad 1 and Ryad 2 computer series are copies of systems produced by IBM, the U.S. computer giant. The Soviet Agat microcomputers are using the design and architecture of a successful model manufactured by the U.S. Digital Equipment Corporation. Moreover, many microchips are identical with American modules by Texas Instruments. For the past year the Soviets have no longer kept quiet about the U.S. domination of the market. U.S. terminology, for the longest time the international standard in the West, has conquered the Eastern Bloc also. A NATO expert describes the situation as follows: "The Soviets are true addicts; the more Western equipment they get, the more they need"--a major problem for the Soviet Union.

Since the Reagan Administration tightened the embargo on technology exports, the NATO export agency (CoCom) lists of banned products have lengthened. All legal business transactions involving Western high technology have virtually come to a halt. Improved customs checks also made illegal transactions more difficult--unlike former times when smuggled electronics worth billions got through to Moscow unmolested.

Instead of investing in their own developments, the Soviet decided early on to produce illicit copies of successful IBM series. They painstakingly dismantled smuggled IBM computers in Severodonetsk and tried to copy them and naming the copy M 2000. However, the Soviet technicians' efforts to produce a reasonable copy were unsuccessful. Moscow had to turn to its friends in the GDR. The final version of the illicit Russian computer was "made in Germany."

In fact Moscow has not had much joy of any domestically produced electronics. The technical papers available to the public are full of complaints about the difficulties involved in the attempt to feed into or retrieve data from Eastern computers. PRAVDA compared the URAL 14 computers in Moscow's Ministry of Transportation to a six-cylinder engine running on only two cylinders.

The ambitious "Complex Program 2000" is to change all that. Subsidies and specialization are the key terms for revving up the industrial society of the East. In community operated laboratories and enterprises--each with its own key function--, the CEMA countries are supposed to close the gap. The Bulgarians are to specialize in drives and storage, the Hungarians in floppy disks, the Czechs in graphics cards and the Poles in printers. Of course Moscow kept the really lucrative raisins in the cake: The computers proper are to be largely manufactured and sold by Soviet enterprises.

However, the resolute reformer in the Kremlin must expect considerable resistance to the implementation of his ambitious project. Unusual noises were heard to emanate from the ranks of the resentful CEMA countries when the program was adopted a year ago. Czech Premier Lubomir Strougal complained of the lack of "management structures in the national economy." Romania's Ceausescu criticized false priorities that failed to adequately consider his country's urgent need for raw materials and energy. Above all the CEMA countries oppose the financing of the project--to come from loans and funds furnished by the countries involved. Such investments are made at the expense of the standard of living and, therefore, represent a sensitive topic in the Eastern Bloc.

The Soviets had anyway reserved to themselves the last word about the billion project. Overall supervision will be exercised by the Moscow ministries. As regards individual projects, Soviet firms will contractually stipulate the performances to be produced by the "partners" in the other countries. Some CEMA countries were actually compelled to amend their national legislation to allow for the legality of their national enterprises' subordination to Soviet principals.

#### Varying Echos

It is possible that countries such as Bulgaria and the CSSR--whose economic fate is already closely tied to Moscow--see an opportunity in the community program for catching up with the technological standard of the other Eastern Bloc countries. Poland, suffering from the crushing burden of Western debt, or Romania have little to lose. The GDR and Hungary and their advanced industries, on the other hand, are bound to fear devastating consequences.

Hungarian technology is quite competitive within CEMA. Its telecommunication facilities are prized in the entire Eastern Bloc. Resourceful Hungarian software writers have even managed to find Western customers. The small Belgrade [sic] firm Novotrade, for example, has developed computer games for international market leaders Commodore, Sony and IBM.

Close technologies ties to Moscow promise only disadvantages for Hungary. Gorbachev's "Complex Program 2000" was therefore received with some reservations. While the CSSR is involved in two thirds of the projects, Budapest showed interest in only one third.



The GDR is the undisputed leaders in matters Eastern technology. At the present time the technicians of Carl Zeiss Jena are working on a 4-megabit chip that is still on the drawing board in the West also. It is doubtful whether the Soviet Union will be able to keep up.

While U.S.technology is much admired in the GDR, products from the big brother country are often derided. "They can't even manage reasonable paper," a Dresden computer specialist recently complained to a Western visitor. Soviet punch cards tend to get stuck in the readers due to the coarse cardboard. The East Germans--disrespectfully--have dubbed them "Russian birches."

However much the Eastern Bloc countries may need information equipment, the computer era has some hidden dangers for a supervisory country. The KGB is unlikely to desire a future when hordes of teenage hackers may be able to invade the country's national computers. Already the secret police has had some painful experiences in countries where the computerization of private life has proceeded quietly and largely without government input.

CEMA residents have taken thousands of U.S.devices home from abroad--without asking for permission. Ownership of personal computers in Hungary is estimated at 90,000. At least 10,000 Czechs are the proud owners of a British Sinclair model. In Poland half a million Ataris and Commodores are said to sit in living rooms--not subject to any checks. It has even happened that EDP instruction was possible in Polish schools only because parents made their personal computers available--the governmentbeing unable to furnish the necessary equipment.

Polish underground groups early recognized the political potential of the new equipment. They are now using personal computers to write dissident literature. Instead of having to be printed in illegal workshops, this literature is now reproduced and distributed on diskettes.

When Zbigniew Bujak, the former underground head of the banned Solidarity labor union, moved from one hiding place to the other, he always carried a portable U.S. computer manufactured by the Tandy Corporation.

11698

CSO: 2302/29

## HUNGARY: RESOLUTION HIGHLIGHTS PROBLEMS, TASKS OF ELECTRONICS SUPPLY

Budapest FINOMMECHANIKA, MIKROTECHNIKA in Hungarian No 3, Mar 87 p 65

[A resolution dated Sopron, October 1986, signed by Dr Gyula Tofalvi, first secretary: "Resolution of the 1986 Parts Seminar of the Communications Engineering Scientific Association"]

[Text] The Parts Seminar, as a social forum and in accordance with the traditions of more than three decades, reviewed in 1986 also the situation of the development of the Hungarian electronic parts industry and its relationship with the electronics industry as a whole. On the basis of the talks given, the debates which followed and the exchanges of ideas by special groups the Seminar passed the following resolution:

1. The Seminar establishes with sorrow that the developmental possibilities prescribed for the Seventh 5-Year Plan for the parts industry are suitable--taking into consideration the dynamics of the electronics industry as a whole--only for maintaining the relative level of the present situation.

Thus the catching up of the parts industry, within the electronics industry as a whole, cannot start in the Seventh 5-Year Plan either.

2. The Seminar further recommends that the possibility of a more dynamic development of the electronic parts industry be the object of continual study during the Seventh 5-Year Plan.

3. Implementation in the form of concrete contracts of the developmental ideas for the Seventh 5-Year Plan, which were worked out in time, is getting started with extraordinary delay. This delayed start puts at risk the effectiveness of the already modest plans.

On the basis of the actual figures for 1986 and the plan figures for 1987 the Seminar feels that an unavoidable consequence of the low level of starts for the two years (between 20 and 30 percent) will be that the plan goals, already modest, will not be attainable by 1990. The Seminar recommends that the 1987 plan be immediately reviewed and that a plan much more effective than the one submitted so far be accepted and implemented.

4. There must be a solution for the basic developmental problems, inherited in the Seventh 5-Year Plan, of the parts research, development and manufacturing enterprises which took brave initiatives and were enterprising in the Sixth 5-Year Plan and are thus in debt. These enterprises must be offered aid so that they can continue unbroken their initiative taking, enterprising practice in the Seventh 5-Year Plan also.

5. At the Seminar they outlined the changes to be expected during the Seventh 5-Year Plan in assembly technology in the electronic equipment manufacturing industry and the resulting parts design and parts generation changes. Closer and more favorable contacts, compared to earlier years, have developed between parts manufacturers and parts users in these themes.

The Seminar recommends that every means must be used to support the combined, synchronized solution of this assembly technology and parts generation change, thus creating the possibility that the lag in equipment design generational change relative to the developed industrial countries should decrease.

8984

CSO: 2502/67

## HUNGARY: REMIX OFFICIAL PESSIMISTIC ABOUT ELECTRONICS INDUSTRY

Budapest FINOMMECHANIKA, MIKROTECHNIKA in Hungarian No 3, Mar 87 pp 66-67

[Article by Janos Goblos, REMIX: "Timely Questions of Parts Generation Change at REMIX," an excerpt from a paper read at the Parts Conference held in Sopron, 8-10 October 1986. The first paragraph is the summary provided by the journal.]

[Text] In the article the author outlines the difficulties which hold back the evolution of electronic parts manufacture in our country. Within this he reviews the situation and achievements of REMIX and offers a glimpse of the developmental activity of the factory.

The new technological generational change which we call surface mounting first came before the professional public in Hungary 2 years ago at the Siofok Parts Conference. At that time it appeared that, because of international competition, the Hungarian apparatus industry would get into this technological generational change relatively quickly, within 3-4 years, and would receive the support necessary for this from the EKFP [Central Electronics Development Program] or EGP [Central Economic Development and Organization Program for the Spread of Social-Economic Use of Electronics]. For this reason we at REMIX worked out in very great detail a plan which, on the one hand, formulated a renewal of the assortment of our passive RC elements and, on the other hand, supplemented our insulation base hybrid integrated circuit program with planning and technological development activities connected with surface mounting. The essence of our thinking was that, contrary to the world trends, we predicted a growth of 5 percent per year in the domestic market for traditional wired terminal parts and 11 percent per year for surface mountable parts. Thus, in Hungary by the end of our decade, the traditional parts would provide 80 percent of the market for passive RC elements while the ratio of surface mountable ones would be 20 percent. At that time, even according to the most pessimistic estimates, this ratio would be at least 50 percent but more likely 60-65 percent in the leading electronics countries. It is worth returning to the 20 percent ratio predicted for domestic surface mounting by 1990. In September 1986, at the initiative of the Ministry of Industry, experts from the equipment factories got together and reviewed questions connected with the EGP, or rather the G-5 development program. At this meeting the equipment factories felt that disregarding a few areas the equipment industry would not really be able,

before the end of the decade, to switch their manufacturing technologies and even today the designers of the equipment industry were dealing only rarely with designing prototypes of components based on surface mounting printed wiring.

This rate of development, falling short of all earlier imagination, can be explained fundamentally by the indebtedness and capital poverty. It appears that the Hungarian electronics industry, with a total production of about 60 billion forints per year, not negligible by national economic standards, is without parallel in the world today in regard to its own developmental possibilities, or more correctly impossibilities.

The problem at REMIX was how one must or could translate these ominous signs into the language of our enterprise plan thinking. How far could one go at the enterprise level in assuming the risk of rationally following unambiguously recognized and proven technical and technological development trends when the domestic customer market might not even exist when the development was realized? Or should we permit the opposite, recognize the above mentioned ominous signs and not develop and at the given time get the missing parts from the world market? It is obvious to a Hungarian parts factory today that the first alternative means the greater enterprise risk.

In the previous plan period REMIX carried out developments which were significant measured by its strength and it used considerable bank credits for these. At the beginning of the new 5-year plan, in the interest of unbroken development, we began new significant investments in the interest of modernizing those of our products which could not be modernized in the previous plan period. But we should see that while the enterprise is in a better situation than 5 years ago in regard to technical conditions the postponing of decisions connected with implementation of the Seventh 5-Year Plan is significantly holding back the dynamics of development. Among the causes we have already mentioned the capital poverty, the indebtedness and the postponed decisions connected with the EKGP [Electronic Central Economic Development Program]. It is also well known that the economic possibilities of the country are, to put it mildly, limited. For this very reason one cannot understand why some economic development programs--the G programs--have been bureaucratized away or why the T programs have been divided or why the disadvantages of this division could not have been seen at the time the decision was made.

Another very substantial problem is that many of us frequently undertook and undertake the personal risk of starting some developmental investments out of the technical development fund in the hope there may be in some way a financial legalization of them. The government organs interested in industrial development explicitly encourage such behavior while the financial regime fights against it with very serious material and legal punitive sanctions. In the recent past, in connection with the G-5 program, they asked us why we did not start more investments than the existing ones, machinery requests connected with the investment, and why we did not besiege the KKM [Ministry of Foreign Trade] with more import permit requests. Posing the question was certainly well intended, intended to help, but one must see that the perfect implementation of the wish embodied in the question would lead unambiguously

to an enterprise fund shortage and bankruptcy, not only in the regulator system proposed but in the present one as well.

Among the implementing elements of the central economic development program for electronics there are gigantic, primarily financing, contradictions the resolution of which not one enterprise leader can soberly undertake today within the frameworks of the much mentioned assumption of risk.

In connection with the investment part of the economic development program outlined above one can expect, with the introduction of the added value tax as of 1 January 1988, very serious balance problems at the enterprises, knowing the draft decrees thus far.

Hungarian electronic parts factories today are faced by the following contradictions:

--The system of conditions for the electronic economic development program is burdened with internal contradictions and dilatory decisions.

--The developmental assets and possibilities of the domestic user market are so limited that this market development restraint can have an effect back on the development of the parts industry.

--In regard to their capital strength and manufacturing capacity the domestic parts factories are scaled to the domestic market, as a consequence they cannot bridge over domestic market problems on the world market (not even to speak of the CEMA market).

The goal of the Seventh 5-Year Plan developmental program of REMIX, started 2 years ago, was to bring to the market a new parts generation in the area of passive RC elements and a core of passive RC elements which were surface mountable. Also in the area of our RC elements we planned to realize a reconstruction of potentiometer manufacture, which failed to take place in the preceding plan period. We planned to put into operation, by the beginning of the Seventh 5-Year Plan, a base to supply industry with insulation based hybrid integrated circuits and an experimental plant for surface mounting to spread our experiences with surface mounting.

Our hybrid integrated circuit investment was completed. A plant capable of producing a value of nearly half a billion forints per year is available to industry and we are convinced that by the end of the plan period this capacity will be able to satisfy the rather dynamically growing needs. In the past 3 years the REMIX production of hybrid integrated circuits has doubled and in 1987 it is expected to exceed a value of a quarter billion forints per year. Our customers include 30 enterprises and cooperatives of the electronics industry and a good number of these buy hybrids from us in volumes of 50 million forints per year. Our experts undertake the processing of 60-70 types of customer oriented circuits per year, and that is possible only with computer aided engineering design work. We received significant support for this from the Ministry of Industry and the OMF [National Technical Development Committee].

With the special support of the OMF B a surface mounting printed wiring designing system and photoplotter were installed and put into operation. The attainable drawing fineness is around 150 microns and the software delivered with the machine is suitable for designing 8 layer wiring.

We have begun to bring the manufacturing background for our professional potentiometers to the level which we achieved in the area of resistor-condensers and hybrid circuits. Simultaneously, in accordance with a practice well proven thus far, we would like to carry out a significant modernization in our product assortment.

We are ready with a zero series of DIL label miniature adjustable cermet potentiometers and we will soon have available for testing the same potentiometer from a surface mountable sample series. We are also working on a surface mountable adjustable potentiometer type.

Another group of potentiometers belonging to the profile of our factory unit in Tiszakecske is wire-wound; here we imagined a significant narrowing of the product assortment in such a way as still to be able to satisfy all the needs. First we would like to abolish our wire-wound potentiometers under 5 watts and offer in place of the types which are in any case obsolete a very favorably sized cermet potentiometer which can carry the same load. In appearance this cermet potentiometer will resemble the P701. We are also working on a high linearity version. We are also ready with a precision, single turn wired potentiometer; the P823 will be in series production beginning in 1987. So we are conducting development in a professional direction for both our film and wired potentiometers. By the same token we manufacture high linearity straight wired and film versions to satisfy special needs and we are also ready with development of a studio potentiometer.

We prepared a prototype of a thick film chip resistor and we purchased for our subsidiary in Szombathely a machine line capable of manufacturing MELF resistors.

By the middle of the plan period REMIX will be making metallised synthetic foil surface mountable chip condensers.

It is unfortunate that on the basis of our earlier surveys we planned manufacture of 10 million chip resistors for 1987. In contrast to this, in 1986, there were customers for only several tens of thousands of chips, although approximately 2 million chip resistors were available from our experimental manufacture.

Concrete interest in surface mounting is far below our hopes. (I am not thinking of business interest but only of interest in information.)

We began a comprehensive redesign of the potentiometer profile thinking on the order of a hundred million forints, but the final financial sources for this require clearing up, to put it mildly. This is the assumption of risk about which I spoke at the beginning of the article and in which we went to the limit of sober reason.

Having thick film technology we are also developing nonlinear resistor chips, but the interest of the domestic market is negligible. The same applies to microinductivity (chip inductivity).

#### Summary

What has been said was deliberately divided into two parts with different content and emphasis. The first part tried to tie in a bunch those problems which work against enterprise and national economic interests, not only in the electronics industry but in every branch of the economy where electronics are built in or used. The second part seeks to show that despite the external economic conditions REMIX is trying in accordance with its best convictions and in harmony with world technical development trends to follow this development at a respectable distance in its own area and with its own modest assets in the service of industry as a whole.

8984

CSO: 2502/67



## HUNGARY: PAST, FUTURE RESEARCH AT COMMUNICATIONS ENGINEERING MATERIALS FACTORY

Budapest FINOMMECHANIKA, MIKROTECHNIKA in Hungarian No 3, Mar 87 pp 68-69

[Article by Jozsef Ferencsik, Communications Engineering Materials Factory, Vac: "Product and Manufacturing Modernization at the Communications Engineering Materials Factory." The first paragraph is the summary provided by the journal.]

[Text] The author offers a brief review of research activity conducted at the HAGY [Communications Engineering Materials Factory] and gives a few examples of how they intend to modernize the product assortment during the Seventh 5-Year Plan.

The HAGY has been dealing for three decades with the manufacture of soft ferrites, transformers and printed wiring sheet, passive parts used in the manufacture of entertainment and professional communications engineering devices.

Of the soft ferrites we are the only ones in Hungary manufacturing ferrites based on manganese-zinc. From the outside--in regard to the market situation--this can be evaluated as a favorable circumstance. Our enterprise always regarded the manufacture of ferrites as a supply obligation. The manufacture of shaped bodies made large series manufacture necessary. We manufactured some of the ferrites manufactured in large series for export and for years the sales receipts for these products were able to cover the foreign exchange needs for domestic products involving special quality or small series use. In recent years--especially since the first years of the Sixth 5-Year Plan--domestic needs grew dynamically. This offered the possibility to expand production but the material assets needed for this were not available to us. We achieved a limited production expansion with "selective development" by putting the work force and tools of production freed by stopping manufacture of television deflection rings, which were demanding of primary material but required little intellectual investment, in the service of manufacturing professional ferrites. As a result of this we succeeded in increasing manufacture of the more valuable ferrites to a considerable degree with relatively little material investment.

The quality demands for ferrites have increased. Recognizing this we directed our research and development activity at creating preconditions for

manufacture. In this period we developed and began series manufacture of the M2-TNA material, an equivalent of the PHILIPS 3C8. One can achieve the high initial permeability, small loss factor and good temperature and time stability only by technological modifications in ferrite manufacture which contradict one another.

In the initial phase of the research it became obvious that the purity of the primary materials has a fundamental effect on the magnetic parameters of the final product. Reducing the silicon, alkali and alkaline earth content of the ferrites increases initial permeability and induction and reduces loss. The results of mass manufacture also confirmed this recognition. But increasing the demands made of the purity of the primary materials is naturally a factor which can be expressed in value and so it has an effect on the economicalness of manufacture.

The other chief direction of research was a study of the effect of additives. So far we have analyzed the effect of titanium and cobalt, separately and in combination. We will continue this research. In the future we will place the chief direction of research on a study of the question of additives, but we will continue the study of primary materials.

A third factor, not to be underestimated, which derives from the mass manufacture conditions for ferrites is precisely maintaining the ratios of the chief constituents and ensuring their even distribution. The available manufacturing equipment represents a serious constraint in the production of ferrites, so improving the magnetic properties of ferrite materials cannot be solved without a modernization of the technological tools.

Our enterprise could not replace our manufacturing equipment or obtain modern technological equipment by relying on its own material resources. From our own resources we were able to obtain only a few new and used pieces of equipment, which preserved the obsolete technology and further increased the obsolescence of the manufacturing line.

With the start of the Seventh 5-Year Plan the Electronics Central Economic Development Program (hereinafter, EKGP) offered a possibility for a replacement of the more important, basic machine lines crucially determining the quality of the ferrites and thus we could think of introducing a modern technology. The large investment which began in December 1986 will mean a reform in the life of the enterprise in technology and in product quality and will offer a guarantee of a 30 percent expansion of production.

Following the investment we must achieve in large series manufacture quality equivalent to the SIEMENS N 48, for transmission technology purposes, and to the SIEMENS N 67, for power electronics purposes. Going beyond this, naturally, we must increase the reliability of the material types figuring in our product assortment and must ensure within the deliveries a smaller spread in the parameters of the products. The preferential credit and support offered by the EKGP and the material contributions of users have created a real possibility for the investment.

We realized manufacture of permanent magnets during the Sixth 5-Year Plan. The volume of production reached 40 million forints in 1986. The characteristic shaped bodies are small motor segment magnets and loudspeaker magnets but in addition there is manufacture of innumerable magnets, primarily isotropic ones, with the dry pressing technology.

The magnetic parameters which can be guaranteed are:

For anisotropic magnets:

$B_r = 360 \text{ mT}$ ,  
 $H_c = 215 \text{ kA/m}$ ,  
 $(BH)_{\text{max}} = 25.5 \text{ kJ/cubic meter}$ ;

For isotropic magnets:

$B_r = 190 \text{ mT}$ ,  
 $H_c = 120 \text{ kA/m}$ ,  
 $(BH)_{\text{max}} = 6 \text{ kJ/cubic meter}$ .

The manufacture of anisotropic magnets can be realized only with a very great tool cost, which puts a limit on broad use. The product can bear the tool cost only in the event of large series manufacture. In many cases this represents an insurmountable obstacle to the development of new designs, the conduct of experiments or production in an initial small series. For this plan period we plan to increase our production volume by 25-30 percent, which can be regarded as realistic. Neither our material assets nor our space conditions make a further expansion possible.

In addition to the manufacture of anisotropic magnets we realized, as the result of the enterprise's own technical development, the production of isotropic magnets made with a dry procedure and thus substantially cheaper in tool costs. In regard to its magnetic properties this product remains below the anisotropic magnets made with a wet procedure but even so they can be used in innumerable places and experience indicates a dynamic increase in demand.

Possessing the manufacturing and technical conditions for isotropic magnets we began research on technologies for dry anisotropic magnets. Our research achievements do not yet make it possible for us to make a statement about the magnetic parameters which can be achieved or about a possible time for starting manufacture. In the event of a compromise pertaining to magnetic parameters the procedure would make possible the production of anisotropic magnetic shaped bodies with little tool cost.

Also for nearly 30 years the manufacture of communications engineering transformers has been a component of the profile of the enterprise. In contrast to several international examples the centralization of manufacture could not be realized in our country. The manufacture of transformers increasingly became the task of apparatus manufacturers, or smaller producers are taking over the production of this product.

Our enterprise held on to manufacture of a few transformer types needed in large numbers in entertainment electronics. The reason is partly that the assembly line based on the patented E-T type core sheets ensures productive

manufacture and partly that it is based on a few types of ferrite cores, which results in a product at a higher degree of preparation. We do not expect in the future any substantial change in the design of or manufacturing conditions for this product or in the division of labor.

A new product among the products of a transformer type is the inductive interference filter. We developed a modern current compensated type of this and we developed a technology suitable for series manufacture of it. It is based on a ferrite toroid ring cast with synthetic resin and placed in an injection molded plastic housing; the 1A, 2 x 39 mH version meets the modern requirements known today. This product is built primarily into switching operation power units, but one must also reckon with a tightening of the network interference filtering requirements which could result in ever broader use of this product. The single type we manufacture in large series now is sold only on the capitalist market but we are counting on domestic demand in the future.

The third product family which serves the interests of electronic apparatus manufacture is the printed wiring sheet, about which there has been so much trouble. The idea of the organizers of the industry in the initial period of the manufacture of this product family was to concentrate manufacture at one site. But the dynamic growth in domestic demand did not make this possible. Today many enterprises--primarily from among state apparatus manufacturers--have set up to produce printed wiring, and the share of cooperative and agricultural auxiliary plants is respectable also. Large industrial bases have been created, even outside state industry, but in addition several apparatus manufacturers have also set up to produce printed wiring. The situation developed basically as a result of the lack of capital for parts manufacturers and out of efforts by apparatus manufacturers aimed at flexibility and reducing production costs.

Our enterprise is the only parts supplier in state industry but our production covers only a fraction of domestic needs. The aspiration of the enterprise is to improve quality and reliability, and we have done everything within our power for this. In the course of the Seventh 5-Year Plan we developed a significant investment program within the EKGP which regards raising the quality level of the product, in addition to expanding production, as a stressed factor. The investment will make possible the production of very fine line printed wiring sheet with the most modern surface preparation, suitable for the surface mounting technology, and we will introduce instrumented monitoring of the sheets. Our goal is to ensure the manufacture of the printed wiring needed for the use of the surface mounting technology, which has begun in our country--and for which the initial steps have been taken. Unfortunately the sheet covered with copper foil of suitable quality needed for manufacture can be obtained almost exclusively from capitalist import.

We are conducting research in several directions in the interest of expanding the product assortment for printed wiring. We have experimented with production of flexible wiring and we took initiatives to organize manufacture of foil keyboards. But these ideas did not realize the hopes attached to them; the use of rigid printed circuit sheets still reigns in electronics and in other use areas.

For a long time the leaders and technical development experts of our enterprise have thought about the manufacture of complete electronic units made partly from parts we produce ourselves and partly from other acquired elements. Our first achievement in the area of apparatus manufacture was to begin, in 1986, manufacture of the high voltage ignition units needed to operate gas and oil boilers, which will make the previous capitalist import unnecessary. Large series manufacture began with modern tools. The design of additional products and creating the preconditions for their manufacture are stressed technical development tasks. Strengthening the electronics line and introducing new products will contribute to transforming the product structure of the enterprise, which is a vital question today in the sharpening market competition.

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## POLAND'S ROLE WITHIN CEMA S&amp;T COOPERATION

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[Article by Zbigniew Szalajda: "Prospects for Scientific and Technical Cooperation Among the Socialist Countries"]

[Excerpts] The CEMA countries now produce more than 25 percent of the world output of machinery and equipment; however, their proportion in the world trade of these goods is only about 10 percent. The proportion was 14.3 percent in 1955. That year the Western countries exported 8.1 percent of the output of their machine industry, and the CEMA countries, 7 percent.

In 1985 this indicator was already 29.1 percent for the industrialized capitalist countries and for the CEMA countries only 10.1 percent. This development of the indicators of the value of production and export results primarily from low prices (caused by poor quality and the outdatedness of the exported products).

According to our conservative judgment, 10-12 percent of the products produced for multilateral agreements on specialization and cooperation--and thus those given particular interest--meet world standards. The results of studies show, for example, that among nearly 500 types of machines and equipment for the food, power, and chemical industries and for road construction only 25 percent meet the average world standard; 52.3 percent require modernization; and 23.8 percent should be discontinued.

In the Western countries the trend toward limiting the international transfer of technology and to use it as a weapon in political maneuvers is growing, especially against the socialist countries. Practically, it is an official element in the strategy of the U.S. This strategy is implemented through COCOM, which is increasingly sharpening its control of exports of technology to the socialist countries. The majority of Western firms have observed the limitations imposed by COCOM, in spite of their verbal declarations to the contrary. There is the danger that rapid technological innovation will contribute to the further division of an already divided world.

The existence of a technology gap between the CEMA countries and the most advanced capitalist countries is a challenge which we can and should meet by our united efforts. The countries of the socialist community have a large

personnel potential which is an incontrovertible achievement of the practical realization of socialism. It suffices to say that the CEMA member countries have nearly one-third of the world's scientists; they publish nearly 40 percent of the information about inventions and receive about 20 percent of the world's patents. The proportion of investments on research and development in the national income of the socialist countries is nearly double that of the advanced capitalist countries. The results do match the capacity used. In general, the causes of this state of affairs and the limiting barriers are known. Eliminating them is possible; changes should produce decidedly more effective use of the science, research, and technical capacity of our countries.

Among the many aspects of socialist integration, cooperation of the CEMA member countries in the acceleration of scientific and technical advancement has moved to the fore. This is most understandable, for it plays a central role in the economic policy of the fraternal countries and is becoming an increasing factor in integration.

In recent years the cooperation of the fraternal countries in science and technology has been limited to individual projects, which had no systematic influence on the development of their science and technology. Now it is time to shift to broad integration of the CEMA member countries for all basic problems of scientific and technical advancement. This must be done in order to effectively and systematically use the potential of cooperation in scientific and technical advancement to intensify production, increase its efficiency, transform the productive capacity of the fraternal countries, implement the technological reconstruction of their national economies. These tasks, dictated by the domestic and the international situation, correspond to the socialist community's character and its historical mission.

The economic meeting of the CEMA member countries at the highest level held in Moscow in 1984 emphasized that the joining of the efforts of the fraternal countries in the key areas of intensifying production and accelerating scientific and technical advancement is of particular importance for the common solution of tasks of historical significance--taking over the leading position in science and technology in order to increase further the well-being of the nations and strengthen their security.

There agreement was reached on the common preparation of the "Comprehensive Program for Scientific and Technical Advancement to the Year 2000" as a foundation for the development of agreed, and in some areas a uniform, policy of science and technology in order to solve more quickly with common efforts the most important problems in the area of science and technology and implement production using the results in the interested countries on mutually beneficial terms.

The "Comprehensive Program for Scientific and Technical Advancement to the Year 2000" (CPSTA) was prepared in a short time and signed by the premiers of the socialist community states on 18 December 1985 during the 41st (Extraordinary) Session of the CEMA. The special character of the CPSTA lies in its providing for selected priority directions from fundamental scientific idea to concrete new technologies, the development of new generations of

highly productive machinery in all moments of the cycle from science to technology to production to sales. The economic effects will be achieved by organically joining science with production, by the broad use of new techniques and technology.

The implementation of the CPSTA will permit the fraternal countries to enter the 21st century with production on a qualitatively new level. By 2000 productivity should have at least doubled; material and energy consumption per unit of national income produced should have noticeably declined; significant changes in the service of information management should have been achieved; and the whole mechanism of organizing production should have improved.

The planned results can be achieved only by concentrating material and intellectual resources on those directions of scientific and technical advancement that ensure genuinely revolutionary transformation of the social production by the end of the present century.

The program includes 93 problems, concentrated in five priority directions.

1. The Electronization of the national economy (34 problems). This direction aims to use broadly computer and microprocessor technology in order to fundamentally transform the base and the management system of the national economy, accelerate scientific and technical advancement and qualitatively to transform services for society.

Part of this direction are the tasks of developing and beginning the production of among other things:

--a new generation of ultrafast computers making 10 billion operations per second, using artificial intelligence, --personal computers with a developed assortment of programs for broad use in scientific research institutes and design offices, in education, and in daily life, --fiberoptic communications, a new generation of satellite communication systems, of television transmission, of a broad range of apparatus, detectors, and equipment based on microelectronics.

The CPSTA assumes that the implementation of these tasks will permit the achievement of a significantly higher rate of growth of the national income, of productivity in all spheres, a reduction in material consumption in production by a factor of 2 or 3, a reduction of energy consumption by a factor of 1.5 to 2. In the area of science, design, and construction, the use of computer systems will make possible a double or triple reduction in the preparation time required.

2. Comprehensive automation (13 problems). This direction is to develop systems for automated design and control of technological processes and includes the development of flexible, automated production systems, rotary and conveyor lines, industrial robots, automated equipment with control systems, precision equipment and precision measurement technology, and automatic control of technological processes and equipment, ensuring their reliability, and also a broad use of integrated systems.



The implementation of this part of the CPSTA should shorten production time by a factor of 1.5, reduce required labor by a factor of 2, shorten technological preparation by a factor of 1.5 to 2, and also ensure a broad compatibility of the products made in the CEMA countries.

3. Accelerated development of atomic energy (17 problems). This direction includes improvement and expansion of nuclear power plants with WWER-440 and WWER-1000 reactors, the development of new, effective methods and means of processing, transporting, and storing radioactive wastes, the construction of nuclear heating plants, and equipment for fast neutron reactors.

The results of the work should qualitatively transform the power industry, increase the efficiency and the reliability of the power supply, reduce the consumption of fossil fuels, improve the supply of heat to cities, and protect the environment.

4. New materials and the technology to produce and process them (10 problems). This direction includes the development and industrial production of materials which in comparison with traditional ones have such valuable properties as: increased resistance to corrosion and radiation, resistance to high temperatures and wear, high purity and others, which will be the foundation for a new generation of technologies.

Part of this direction is the development of ceramic and composite materials, with unusual amorphous and microcrystalline properties, semiconductor materials for microelectronics, new artificial materials, the development of a series of technological lasers and applications in various industrial operations, new methods of applying coatings, methods for continuous steel rolling, technological syntheses of superhard materials.

5. Accelerated development of biotechnology (19 problems). This direction synthesizes the latest achievements in microbiology, genetics, physiology, and many other scientific disciplines. It opens the way to real chances to solve such basic problems as further enlargement of food resources, satisfaction of the national economy's need for raw materials, mastery of new energy sources, initiation of new types of no-waste production, prevention and rapid treatment of severe illnesses, reduction of damage to the environment.

For each of the five priority directions of scientific and technological advancement, appropriate offices of the CEMA and international commissions responsible for their implementation have been named. It has been agreed that the basic form of cooperation will be agreements, conventions, and contracts. Significant expansion of direct cooperation between enterprises, combines, and scientific and technical organizations of the CEMA member countries is planned. So far such cooperation has usually been limited to exchanges of information, but now contacts and direct relations in scientific, research, and production operations will come to the fore. Intense work is underway to create the appropriate organizational, legal, and financial and economic conditions for developing this cooperation.

The next step in the development of direct relations, a still higher form of implementing the CPSTA, will be the creation of multilateral common firms and

enterprises. This will permit the concentration of the scientific and technical capacity of the CEMA member countries on the solving of the priority problems of the CPSTA. The socialist countries have some experience in this area. At the 41st (extraordinary) session of the CEMA one more important step was taken in this direction with the signing of the multilateral agreement on the creation of the international scientific and production combine Interrobot. Its major task is the linking of constructor's efforts, the development of robotics methods in all the interested CEMA member countries. First we must develop the parameters for new robotics methods that guarantee a world-class level and on this basis create a uniform system of robots for different purposes, both as independent units and as part of automated production systems.

It was also decided that the agreed cooperative undertakings to implement the CPSTA will be financed using the resources of the CEMA member countries, CEMA bank credits, and common funds formed by the interested countries for financing important undertakings that will be set out in agreements and contracts.

Poland has made its entire scientific capacity of highly qualified personnel, talented creators of technology and scholars of world renown, available for the implementation of the CPSTA. In 1985 there were 65,600 scientists in Poland: including 46,100 in higher education, 18,100 in the research centers of the Polish Academy of Sciences, and 15,100 in industrial research. In all scientific research and the development of technology employs almost 160,000 people. In some areas they have available the latest scientific equipment. Nationwide the research and development units have 150,000 zloty of equipment for each employee. In Poland's 92 institutions of higher education, in 22 academic centers, there are 370,000 students in 130 disciplines; each year 63,500 individuals receive university degrees. Despite the lower level of activity by the scientific community in 1981-85, 2020 received professor titles; 2,615 received their doctor habilitatus; and 13,527 received their doctorates.

The importance that the highest state authorities attach to the development of science and technology is shown by the investments for science and research as part of the national income, which rose from 1.2 percent in the crisis year of 1982 to 2.2 percent in 1986 and which should reach the level of 3 percent by the end of this five-year period. Recently investments for science and development of technology have constantly risen; while in 1982 they were 3,810 billion zloty, in 1984 they were already 5.515 billion zloty.

This entire scientific potential concentrated in the 92 institutions of higher education, 1,147 research centers, and 727 development units is available for implementing the five priority directions of the CPSTA and will surely be used to the degree that results from the fact that in the socialist community we have significant science and research facilities.

As part of the scientific and technical cooperation of the CEMA member countries, we will make available the achievements of Polish science and technology, work at the highest world-class level.

In the area of electronization Poland will contribute to the development and implementation of production of highly integrated circuits, including microprocessors. In the area of computerization we have many years of experience in the construction and production of input-output equipment for microcomputers, of various types of printers and monitors using high-resolution kinescopes. Poland can participate in the construction of telephone lines and exchanges based on fiberoptics.

In comprehensive automation we want to propose the use of such achievements of ours as control systems for orbiting objects, some types of automation and measurement equipment, particular types of robots, particular flexible control systems for production, and also the results of engineering work on automation.

Poland produces equipment for nuclear power plants, studies reliability and safety of power reactors, etc. This equipment and the research results will serve all participants in the implementation of the CPSTA. Besides this, in the development of heat systems using nuclear energy, our achievements in the construction and operation of heat systems will be used.

We propose the use of experience in the development and introduction into production of new types of artificial materials, particularly those for structural elements of machinery and equipment and also new amorphous and microcrystalline materials with excellent mechanical, electrical, and anticorrosion properties. We wish to share our achievements in the use of technological lasers for cutting, welding, for processing plastics and thermal metals.

In the area of the development of biotechnology, Poland will actively participate in the most rapid development and production of new, more efficient antibiotics and veterinarian medicines.

We are interested in participating in the development of new technology for producing preparations and agents to raise the effectiveness of plant and animal production, serving the production of food and protecting society's health.

In general, the whole scientific, research, and production capacity of Poland, which has developed and introduced into production new materials, products, and technologies, will enable Poland to contribute significantly to the implementation of the CPSTA.

An essential condition for the concentration of the efforts of the countries participating in the implementation of the CPSTA is close association with it of other, bilateral programs of scientific and technical cooperation.

The Long-term Polish-Soviet Comprehensive Program for Scientific and Technical Advancement, which is most important for the economic interests of Poland and which was signed in September 1985, was developed on this premise; it calls for intense development in seven main directions of which the first five coincide with the priority directions in the CPSTA.

Given the character of bilateral cooperation, the long-term tradition of cooperative relations and the interest of the partners, the Polish-Soviet program was expanded by the addition of two main directions: --the development of the machine industry, --modern consumer products.

Many of the 94 problems in the Long-term Program are being worked on by research and development units in Poland and the USSR as part of direct cooperation. Four tasks are being worked on over the whole cycle, including research, development, implementation, and mutual shipments under the direct supervision of the chairmen of the Committees of Science and Technology of both countries. They are: 1. the development and introduction into production of digital color television sets for Poland and the USSR, 2. the development and introduction into production of a 3.5-ton truck with a high compression engine, 3. the development and introduction into production of a new generation of self-propelled cranes with a lifting capacity of 25 to 250 tons, 4. the development and introduction into production of a new generation of brakes and electromagnetic clutches.

The Council of Directors formed in March 1986, which organizes direct scientific and technical cooperation, should facilitate the implementation of the Long-term Program.

In Poland we have completed the first stage in the preparation and implementation of the CPSTA and the Long-term Program, the organization of cooperation.

To ensure the necessary organizational, economic, and legal conditions for the implementation of the CPSTA and the Long-term Program the Council of Ministers issued a special resolution on 7 April 1987. According to the resolution the Chairman of the Committee for Scientific and Technical Advancement of the Council of Ministers supervises the implementation of the programs, while the minister, director of the Office of Scientific and Technical Advancement and Implementation, coordinates the overall implementation. The appropriate branch and sector ministers are responsible for the supervision and coordination of the implementation of the individual priorities.

The Coordination Council has been formed under the Committee for Science and Technical Advancement Affairs as a consulting and advisory body, which includes the appropriate ministers, the scientific secretary of the Polish Academy of Sciences, and the president of the National Bank of Poland. Among its tasks are the establishment of the financial and material needs essential for the implementation of the cooperative programs, evaluation and initiation of economic, financial, legal, and organizational measures, making period evaluations of the implementation of the programs and informing the Council of Ministers of the results.

The appropriate ministers have designated the leading units for each problem and given them the necessary authority to make direct contacts with foreign units participating in the implementation of the tasks. The principles for coordinating the units leading the activities of the other organizational units participating in the implementation of the programs and the principles of cooperation between the Office of Scientific and Technical Advancement and

Implementation and the ministers and the central offices in this area have also been settled.

In accordance with the resolution of the Council of Ministers, the obligations resulting from international conventions, agreements, and contracts that apply to the implementation of the programs are to be included in the National Socio-Economic Plan for 1986-90 and the central annual plans. The Planning Commission of the Council of Ministers will assure the essential material and financial resources for their implementation; the minister of foreign trade is responsible for including specialized and cooperative products obtained as part of implementation of cooperation and for the appropriate agreements and contracts, regulating the exchange of goods.

By 1 October 1985 Poland had signed 46 agreements and 38 protocols (to agreements signed in previous years) formalizing our participation in the CPSTA.

Thus, in the implementation of the direction --"Electronization of the national economy," 105 Polish units, of which 24 have been designated leading units, will participate; --"Comprehensive automation," 100 units, 14 leading, will participate; --"Accelerated development of nuclear energy," 41 units, 10 leading; --"New materials and the technology for producing and processing them," 34 units, 9 leading; --"Accelerated development of biotechnology," 30 units, 16 leading.

In all 310 units, including 70 leading units, are participating in the implementation of the CPSTA.

Under the Long-term Program so far 34 agreements have been signed, and 135 Polish research and development centers are participating in their implementation.

The implementation of many economic, financial, and organizational undertakings to serve, among other things, the effective implementation of the CPSTA is continuing in Poland. Primarily, a modified system of planning and implementing scientific, research and development, and implementation has been developed. After analyzing the weak aspects of the system for controlling scientific research and development (such as: excessive division of problems, late completion of tasks, the lack of financial discipline, the insufficient rate of implementation), it was decided to introduce a new system for controlling scientific and technical advancement at the beginning of the five-year period (1986-90). Coherence in the state's scientific and technical policy, in its strategy, and in the organization of the system for controlling scientific and technical advancement was adopted as the foundation for the new measures.

The Polish system for controlling scientific and technical advancement has a three-level structure. The first level consists of the Committee for Science and Technical Advancement of the Council of Ministers and its decision making body, the Committee's Presidium, and its executive body, the Office of Scientific and Technical Advancement and Implementation. At this level the most important decisions are prepared and the general function of planning and

coordination of the development of science and technology are ensured. The plan for scientific and technical advancement is included in the National Socio-Economic Plan created for the five-year period.

At the second level, the ministries, the scientific and technical advancement of particular branches, which were not included in the central plan, is formulated, and the coordination of the central programs and government commissions assigned to the ministry's supervision is ensured. At this level the Polish Academy of Sciences and the Ministry of Science and Higher Education play important roles. These institution not only supervise the implementation of their ministerial research programs but formulate and implement the Central Program for Fundamental Research.

The third level, implementation, consists of the scientific research and development units, the branch institutes and the industrial research facilities, which implement the assigned tasks in the central, ministerial, and their own development programs. This level also includes those units coordinating the implementation of the central research and development programs, established at the first level, and fulfilling their function on the basis of general contracts and coordination plans drawn up by the Office of Scientific and Technical Advancement and Implementation and the particular ministries.

The organizational conception of formulating scientific and technical advancement adopted, which reduces to seeing the Committee as the representative body elaborating decisions in the area of the state's scientific and technical policy, the Presidium of the Committee as the strategic decision making body for scientific and technical advancement, and the Office of Scientific and Technical Advancement and Implementation as the executive body, should permit us to achieve the above mentioned principle of coherence in the state's scientific and technical policy.

In developing the premises of the state's scientific and technical policy, the Committee was forced to plan two periods. In the first, which should last no longer than five years, we should discount all the positive results of our previous system of government and key programs and liquidate its faults, to prevent them from moving to the new system. We should in this period overcome the financial and payments barriers so that the national economy can again develop.

During the first period we will prefer research and development tasks that can be quickly implemented and have a high rate of return in order to create the conditions for approaching a modern Polish economy in 1991-2000, in order during this second decade-long period for scientific and technical policy to become an effective component in the socio-economic development policy of the country, implemented in close connection with the program aimed at modern structural changes in the national economy.

Besides work on the National Socio-economic Plan for 1986-90 and the setting up of the organization of research work in Poland, the Committee undertook, and attaches to them great attention, actions to remove obstacles to implementing the competed programs encountered in industry. The most important

system measures, both economic and organization, look in this direction. Today work on the improvement of credit and tax mechanisms, which should encourage implementation by industry, is well advanced. We are endeavoring to have implementation decisions made sufficiently well in advance, and the decisive factor should be the appropriate method for rationally weighing risks and final effects.

Introduction of effective disciplinary measures in the area of research and development facilities, i.e., in the area of activities of scientific and research institutes, research centers and central laboratories, is the second important element in our strategy for scientific and technical advancement. To this end, we will take actions to strengthen these facilities, including, among other things, the establishment of stable legal mechanism, the implementation of an efficiency-oriented economic and financial system for the units' activities, the satisfaction of the most important needs for equipment, the protection of continuity in creative workshops, and finally, an innovation-oriented attitude.

Striving to ensure the appropriate roll for central financing of scientific and technical advancement is an important component in our new strategy. To this end in 1986-90, we are using three types of financial resources: a central fund for research and development work, a central fund for aid in implementation, and a central convertible currency reserve. These funds finance participation in the priority directions in multilateral and bilateral cooperation, which accord with the fundamental tasks required by the needs and socio-economic development plans of the country.

All our actions, both those concerning the control of scientific and technical advancement as well as those aimed at more effective forms of scientific and technical cooperation within the socialist community conform to the principles formulated in the resolutions of the 10th PZPR Congress, which confirm the need to strengthen the link between science and production, to create organizational forms in science, technology and implementation that will make possible fuller and more rapid use in practice of the results of common scientific and technical developments, to ensure science a decisive role in increasing labor productivity, to reduce energy consumption in production, and to accelerate generally scientific and technical advancement.

For Poland, the implementation of the CPSTA of the CEMA and the Long-term Program has another important asset: it provides our country with a guarantee of security in international economic relations. It opens the way to a real opportunity to reduce our technological and cooperative dependence on the capitalist countries and to reduce the West's use of existing economic relationships for political purposes. Poland's inclusion in the long-term plan of technical development of the USSR and the other CEMA countries guarantees movement along with the main current of the world scientific and technical revolution.

The success of our plans depends on ideological and political unity, the defense community, the unceasing growth of the economic potential of our countries, and the friendship of our nations.

The CEMA member countries undertaking of the implementation of the CPSTA is an historic decision for the entire socialist community, for the good of our countries. The task, we have taken up, transcends national boundaries. Its implementation requires uniting our material and intellectual resources. This will be possible only through a creative approach, by resigning from well-worn schemes of cooperation where ever they restrain this most important, gigantic, common labor.

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