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SPRINGFIELD, VA 22161

Science & Technology Europe

JPRS-EST-92-004

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6 February 1992

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ADVANCED MATERIALS

EC: BRITE-EURAM II Applied Research Program for 1991-1994 Funded

92WS0168A Paris INDUSTRIES ET TECHNIQUES
in French 01 Nov 91 p 22

[Article by Michel Le Toullec: "BRITE-EURAM II: 4.5 Billion for Applied Research"]

[Text] The future European program for industrial technologies and materials earmarks a large section for PMI (small and medium-size industries).

BRITE-EURAM is (almost) dead; long live BRITE-EURAM II. Also known as TIM (Industrial Technologies and Materials), this third research program of the European Community has picked up the torch for the 1991-1994 period. The budget reaches 663.3 million ecus, a clear 4.5 billion francs. Unlike its predecessors, the approach of this program is industrial rather than technological. Its other new feature is a cooperative research procedure intended for PME (small and medium-size enterprises) that are underequipped for R&D.

Three-fourths of the budget is devoted to applied research. The work involves at least two enterprises from two member nations, and their industrial results are expected in the future (three years after the end of the project). Public aid (from 1 to 5 million ecus) covers no more than 50 percent of the project. Manufacturers must provide at least 35 percent of the financing.

The real innovation concerns cooperative research and its CRAFT (Cooperative Action for Technology) procedure, to which 8 percent of the budget is being devoted. It provides an assistance of 0.4 to 1 million ecus for PME/PMI's faced with R&D needs (those that have less than 500 employees and revenues lower than 38 million ecus, meaning 250 million francs). PMI's can call upon research centers, universities, or even other enterprises to perform research in their name, with a guarantee of retaining the industrial property. Lastly, the program provides assistance for feasibility studies, for concerted actions on targeted areas (private cars, TGV, and so on), not to mention the funds dedicated to training, in the form of scholarships or course allowances.

BRITE-EURAM II's first stage covers materials and raw materials (47 percent of the budget). It includes structural materials (metals, ceramics, polymers, composites, and advanced glasses); functional materials (biomaterials, as well as magnetic, superconducting, electrical, and optical materials); and materials commonly used for packaging or construction. Raw materials research incorporates exploration techniques, mining technologies, and ore processing. It also covers a section on industrial waste recycling and the reutilization of new materials.

By the same token, 45 percent of the budget is earmarked for design and fabrication research. It concerns tools and

systems, with particular stress on the use of advanced materials and process engineering.

The third field covered by TIM, aeronautics research (8 percent of the budget), approaches environmental technologies such as reduction of noise and of combustion emissions, structural design, aerodynamics, and avionic technologies in general.

Interested parties must submit their research proposals by 28 February 1992. The probable date for starting the contract is October 1992. (Rens: 47 07 47 57).

AEROSPACE

Spacelink Created to Promote European Space Technology Transfer

92WS0144A Paris AFP SCIENCES in French
24 Oct 91 p 10

[Text] Paris—A European economic interest group (GIE) to promote the transfer of space technologies has just been founded in Paris. The consortium, dubbed Spacelink, will initially be composed in equal parts of the Novespace (France), JRA (Great Britain), and MST Aerospace (Germany) companies. But, said Spacelink on 14 October, new members, such as the Italian firm D'Apollonia, could be admitted in the future.

The European Space Agency (ESA) entrusted the three companies with the task of implementing its TNN (Technology Transfer Network) pilot program nearly two years ago. The aim of the program was to better organize the process used to transfer space technology. It resulted in the publication in the spring of 1991 of a catalog—TEST (Transferable European Space Technologies)—that Spacelink claims was so successful among non-space manufacturers that it led the three companies to form a group.

Mr. Jean-Pierre Fouquet, the president and general manager of Novespace, has been named president of Spacelink's board of directors, and the consortium's headquarters have been set up in Paris, 15 rue des Halles, in Novespace's facilities.

Auxiliary Power System for Hermes Described

92WS0100B Stuttgart FLUG REVUE in German
Oct 91 pp 62-63

[Article by Heinrich Hemker: "Auxiliary Power Unit for Hermes"; first paragraph is FLUG REVUE introduction]

[Text] The auxiliary power system is crucial to the safety of the crew in the space shuttle Hermes. If it should fail, the mini-shuttle cannot return safely to earth.

The winged messenger of the gods Hermes has brought Garrett luck—in the form of the European space shuttle. The company in Raunheim has been awarded the prestigious contract for development of the APU system

(Auxiliary Power Unit) for the space shuttle. The system delivers hydraulic energy for control of flight surfaces during launching and landing, and during landing it also provides for the extension of the landing gear.

Extraordinary demands are made of the unit. First, there is the necessity of operating under the conditions of weightlessness and of atmospheric pressure, just as an air-breathing APU does in an airplane. This consists, in principle, of a shaft turbine which supplies power via a set of gears to the various users—air compressors, generators, and hydraulic pumps, for the most part.

The added demand on the Hermes APU is that this unit also must function under the conditions of space, i.e., in a vacuum and under weightlessness. In addition, the safety requirements are extremely high, because the APU system is the sole supplier of power for control of flight surfaces. A total failure would lead to the loss of the shuttle.

The requirement to function in a vacuum rules out the use of atmospheric oxygen as the oxide source, thus conventional fuels cannot be used. Therefore, in contrast to normal APU's, the Hermes system has no compressor and no combustion chamber. Instead, the turbine is supplied with autogenerated hot gas. The fuel used, hydrazine, is a so-called monergol propellant, i.e., a one-substance system. Under the action of a catalyst, it separates into a gas mixture, releasing heat. The mode of operation of the Hermes APU is as follows: Hydrazine stored in a tank under pressure from nitrogen flows via the fuel regulating valve into the decomposition chamber. There, the fuel comes into contact with a granular catalyst. As it flows through the granulate, a hot gas mixture forms which is supplied from the decomposition chamber to the two-stage pulse turbine. Via a reducing gear system, the turbine drives the hydraulic pump as well as the secondary systems, i.e., the fuel pump and oil pump.

The shuttle's energy requirement varies on launch and landing as well as with the altitude of flight. During landing, for example, the power required increases as it approaches the ground because the forces on the control surfaces increase as the atmosphere becomes denser. With a speed of 105,000 rpm, the turbine provides up to 54 kW depending on need.

In contrast to modern air-breathing APU's, the Hermes APU requires a system which puts the gears and the oil circulation system under pressure because otherwise it would be impossible to prevent boiling and foaming of the oil in the vacuum. The system functions in two operational ranges: In power operation, the turning gears force the oil into a small accumulator whose opposite end is exposed to slight pressure from nitrogen, with the volume of oil thus displaced also replaced by nitrogen. At rest, the pressure of the nitrogen in the accumulator assures that the oil flows back into the gear housing and fills it.

The sealing of the turbine shaft was a special problem in the construction of the turbine. For the initial speed of 160 meters per second, an ultraprecise slide ring seal was designed whose surface accuracy is in the range of a few lightwave lengths. The desired seal is obtained in conjunction with a counter surface made of a special carbon material.

To obtain the required redundancy and, consequently, safety, the Hermes APU system is made up of three mutually independent turbine modules (Turbine Power Units, TPU's) which are supplied with fuel from two tanks via two valve connection groups. The TPU's drive hydraulic pumps which supply two mutually independent hydraulic circuits of the Hermes with pressure. The fundamental safety philosophy is that one turbine operates while the second runs without load. The third is available as a reserve.

The Hermes APU is designed for a running time of a few hundred hours. In the configuration presented, with two tanks and three turbines, the total weight is 150 kg. Hydrazine consumption per mission is estimated at 128 kg; at nominal power of 54 kW, consumption is a maximum of 3 kg per minute.

The total cost of this project is 40 million marks [DM], a great deal when you consider that only 16 APU's are to be delivered. If you take into account the fact that with this APU it was necessary to push against the envelope of technical feasibility in several areas, the amount becomes understandable. At Garrett in Raunheim alone, 140,000 engineer hours are estimated for the development of the Hermes APU system.

Future of Hermes Spaceplane Discussed

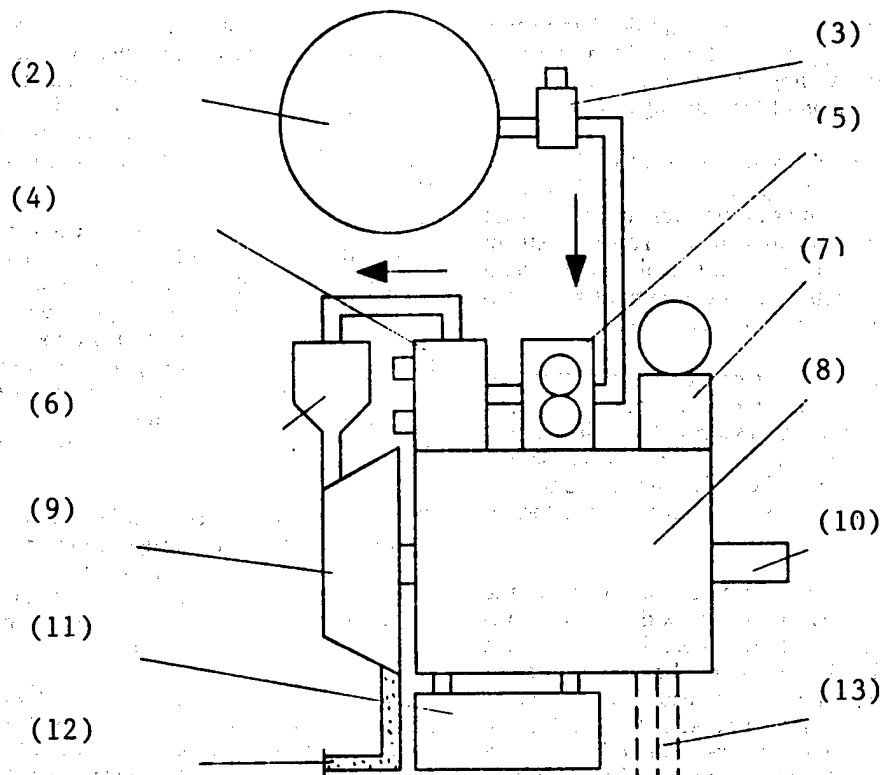
Technological, Financial Problems Remain

92WS0192A Paris LES ECHOS in French
20 Nov 91 p 19

[Article by Alain Perez: "Uncertain Future for European Spaceplane"—first paragraph is LES ECHOS introduction]

[Text] European space ministers have reached a political compromise. The program will be examined each year. Additional cost overruns would doom the project. Now it's up to industry to solve the technological and economic problems.

The latest estimates from the European Space Agency [ESA] indicate it will take at least 50 billion francs [Fr] to build the Hermes spaceplane. The "pi factor" law, which says you have to multiply the first estimate by 3.14 to get the real cost of a project of this kind, proves true once again. Admittedly, this is an especially delicate program, one which probably stretches European technology to the limit. "Hermes has only become really feasible in the last year," says the program's director, Michel Courtois. In fact, getting to the first (unmanned) flight in 2002 or 2003 will require help from a variety of sources,



(1) Schematischer Aufbau der Hermes-APU

Figure 1. The Hermes APU system delivers hydraulic power for the aerodynamic control of flight surfaces

Key: 1. Schematic structure of the Hermes APU—2. Hydrazine tank—3. Separating valve—4. Fuel regulator—5. Fuel pump—6. Decomposition chamber—7. Gear pressurization system—8. Gears—9. Turbine—10. Drive shaft for hydraulic pump—11. Oil cooler—12. Exhaust pipe—13. Wiring links to the APU controller

including various industries currently grappling with some of the developmental complexities.

Three critical points remain to be resolved, according to Courtois: the aerodynamics, the heat shielding, and the fuel cells (2 x 4 kilowatt). "In terms of the aerodynamics, all that remains is to iron out a few discrepancies between the tests and the calculations. The final shape of the craft will be decided before the end of 1993, after which we can begin fabrication. The work on the heat shielding is not coming along as rapidly as we would like, particularly with regard to protecting the material against oxidation during re-entry. As for the fuel cells, we have made good progress in the last year, especially on the electrodes and water control," says Courtois.

European Showcase

So it is clear that Hermes is a technological showcase unique in Europe. Witness the rivalry between the two French manufacturers specializing in materials that are

resistant to high temperatures: SEP [European Propellant Company] and Aerospatiale. Both were competing to build the two most difficult parts of the program, the nose and the leading edge of the wings: two critical sites where the temperature is expected to be on the order of 1,600°C for the 20 minutes of re-entry. The small size of the Hermes is a costly handicap here, since the temperature gets about 200°C higher than the American space shuttle must withstand.

In the end, ESA made the Solomonian decision to give Aerospatiale the contract to provide carbon-carbon shielding for the hottest zones while making SEP responsible for the carbon-ceramic insulating panels on the craft's fuselage. The innovative approach of building the entire airframe out of heat-resistant materials was finally deemed too risky and abandoned in favor of a more traditional system. Hermes thus has an aluminum chassis with protective heat shields. This conservative decision added nearly a ton to the weight of the vehicle.

All of a sudden, especially with the introduction of ejector seats motivated by the Challenger calamity, Hermes has gotten heavier. The craft now weighs 2 tons more than initially planned, which means the maximum payload is correspondingly smaller—currently about 1 ton. This handicap does not overly concern Daniel Sacotte, executive director of CNES [National Center for Space Studies], who believes it is not of critical importance for the initial flights (see interview below).

But the shuttle is not only a technological showcase for high-tech materials—it is also good business for the industries concerned. For the European Propellant Company, Hermes will mean revenues of about Fr3 billion in 1991 francs over a 10-year period. "It is like a big military missile development program," says Jean-Paul Bernard, director of major programs for the firm.

Income for SEP

Current plans (construction of two shuttles) require SEP's facility at Bordeaux to produce 1,000 carbon-ceramic (silicon carbide) panels of identical size (30 x 30 cm) but differing curvature. "It is not really the same as small-batch production. The panels come in more than 300 different shapes. The first deliveries should be made in two or three years, and the series will be completed by 1997," says Bernard. Also, if the program runs to completion, the Bordeaux plant will require a second autoclave to fabricate the protective panels.

This materials production activity alone will generate turnover in excess of Fr2 billion for SEP, which needs it in view of the cancellation of several military programs. The firm is also doing some long-term thinking about other uses for the same materials. "After Hermes, other space vehicle projects will need similar materials. These materials may also have uses in turbojet engines," says Bernard.

In light of the problems apparently created by Hermes's 2-ton increase in mass, the best solution is to upgrade the performance of the Ariane-V's engine. That is another juicy plum for SEP, which is building the "Vulcan" engine at its Vernon facility. Daniel Sacotte believes the current engine is capable of delivering 10 percent more thrust without further development work. But the ever-cautious space agency has nonetheless programmed additional development funds (500 million ECU's [European Currency Units]) to improve the main engine of the Ariane-V. This program might be launched in 1995. In all, 120 European (and Canadian) firms are involved in the Hermes program.

Interview With CNES Official

92WS0192B Paris LES ECHOS in French
20 Nov 91 p 19

[Interview with Daniel Sacotte, executive director of the CNES, by Alain Perez; date and place not given: "Hermes is Above All a Political Initiative"]

[Text] [LES ECHOS] Many French scientists are opposed to new European space programs that emphasize manned flight, which they consider too expensive and of little scientific use.

[Sacotte] This is a reflex born of fear. Scientists see it as a threat, a new player who might take all the available money. Hermes, Columbus and the DRS [high-output telecommunications satellite] transmission system are expensive, demanding projects. Especially since manned space programs are quite many-sided. That is to say, they are not designed solely for science. In the view of many scientists, this is rather incredible, even unimaginable. But one does not send humans into space to conduct experiments on microgravity. Europe is going ahead with these three major programs for political reasons, and the decisions are made by states. The European space effort has come very far. But the two superpowers have something more, and that is precisely manned space flight. If Europe wants to compete, it will have to follow suit.

[LES ECHOS] Where does the European space program presently stand, in comparison to its Soviet and U.S. counterparts?

[Sacotte] We don't have a very clear picture with respect to the USSR. We sent a mission two weeks ago. It returned with a mixed report. There are obviously capabilities there, but for now we don't know who will be in charge or what the policy will be. With regard to the Americans, we spent the last year in a state of confusion. All the press was saying day after day that the Americans were going to abandon the Freedom space station. We were saying the opposite. Finally, the U.S. Congress voted \$2 billion for Freedom. Manned space activity is a high priority for the United States. An eventual return to the moon is probably in store as well. The question we must face is this: Since the Americans are going there, isn't it important for Europe to participate in that program, to gain expertise and be in a position to cooperate in other projects later on? The point where we could run into a fatal disconnect is when we try to weigh that vision against other social problems, such as the suburbs or unemployment.

[LES ECHOS] Exactly how do you make this project palatable to the French taxpayer, preoccupied as he is with other concerns?

[Sacotte] It is very difficult. But from my point of view, man in space is an inevitability. Building Hermes and Columbus gives us a little foothold in another domain dominated by the Americans. For the moment, Europe is not self-sufficient. We must learn how to do it all by ourselves. If we do not build Hermes and Columbus, we will not participate in the following stage, except on an episodic basis. We must become self-sufficient, if we want to be partners. If children are interested in pursuing scientific and technical studies, it is perhaps because

Concorde and the space programs existed. In political terms, they count for something. A society needs to have aspirations.

[LES ECHOS] The manned component is also a very heavy technical constraint. Automated systems perform just as well and cost less.

[Sacotte] All the same, man in space is an inevitability. What we must ask ourselves is this: Will the economic or technical prestige of the United States be increased as a result of this activity? At bottom the real question is, What risk do we run if we decide not to go along and not to play in the same league as the Americans? Our country's leaders think it is in our interest to participate.

[LES ECHOS] Wasn't it more economical to cooperate with the Russians, who themselves were having financial problems?

[Sacotte] Four years ago, the Russians were not ready to work with us. Today, I am not ready to work with the Russians. I don't know who Mr. Yeltsin will put in charge of the Russian space program. Anyway, to cooperate with credible partners you need money and industrial capacity.

[LES ECHOS] Has the cost of the program been fully determined?

[Sacotte] We are presently running 40 percent over what was proposed at The Hague. But we have planned to shut down the program in 1995 if we encounter sizable overruns. At this point, we are committed to provide about one-third of the total funds. If we can compare it to an aviation program, we are very near the end of prototype development, after which we go into production. But we have taken this possibility into account, in order to reassure the finance ministers of participating states. Between now and 1995, Germany will recover, but it is not necessarily in France's interest to wait for Germany's recovery.

[LES ECHOS] The payload problem is still unsolved.

[Sacotte] I'm not a bit worried about that. The objective is to build Hermes, not so much to use it operationally. In other words, the point is to learn how to build it and operate it, to master the skills of space rendezvous, to improve our understanding of what happens during re-entry. The original specifications for the craft called for a three-man crew and 3 tons of payload. For now, the fact of having only 1 ton instead of 3 is not a problem. We can surely improve the performance of the launch vehicle by 10 percent. Up through 2004-2005, Hermes will be a space taxi. We are going to learn to fly it and make it fly people. It's unreasonable to think we will be operational immediately.

[LES ECHOS] How much will it cost to operate?

[Sacotte] On the order of a billion ECU's per year, assuming two launches annually. The operational phase will thus cost nearly the same as the developmental phase that preceded it.

Hermes, Columbus Funding Debated

*92WS0110D Paris LES ECHOS in French
28 Oct 91 p 14*

[Article entitled: "Paris and Bonn Near to an Agreement on Hermes and Columbus"; first paragraph is LES ECHOS introduction]

[Text] The Germans still want to see their financial commitment scaled back, but unlike France, they do not want the Columbus program affected.

With an eye to the interministerial space conference that will be held in Munich on 18 and 19 November, France and Germany, the two main financial backers of European space programs, continue to iron out their differences. According to the first draft of the resolutions to be approved in Munich, the Hermes and Columbus programs and several others—notably relative to the study of the environment—will receive a unanimous green light and be definitively gotten underway. Manufacturers, who have completed the study phase, have been waiting for this political green light for nearly a year.

Although its position has evolved, Bonn, however, is still dragging its feet for financial reasons, and has not yet rallied to the new timetable defended by the European Space Agency (ESA) and France. According to Paris, Germany is still determined to cut its planned share for the next four years by 3 percent. More serious, it would like to see the savings come out of Hermes rather than Columbus, of which it is financing the largest share (38 percent). France is diametrically opposed.

A compromise will therefore have to be found and could be announced when the conference opens in Munich, at a Franco-German summit planned for 14 and 15 November. Paris is somewhat optimistic on the subject. In any event, France will have to resign itself to watching Germany devote the lion's share of its expenditures to Columbus between now and 1995. Although it is likely that an overall green light will be given in Munich to the European space plane and the two components of the Columbus program, a new political rendezvous should be set in 1995. "This new meeting is seen by the European Space Agency as the last chance to give a yellow, and maybe even a red, light to all the programs," remarks an individual close to the matter.

Columbus Space Station Program Encountering Financial Difficulties

*92WS0099A Stuttgart FLUG REVUE in German
Oct 91 pp 37-38*

[Article by Goetz Wange: "Columbus Seeks New Course: Space: Will the Free Flying Lab Be Sacrificed?"; first two paragraphs are FLUG REVUE introduction]

[Text] The German federal government lacks at least 4 billion German marks [DM] for its part of the financing of the large ESA project planned through the year 2000. A reduction in the equipment and a time extension for the Columbus space station will hardly suffice to meet the goal. Consequently, the free flying lab is threatened—a second will be docked on the US space station.

The Columbus APM module which has been shrunk by 20 percent is to be delivered by the shuttle as early as 1998, before astronauts are continuously stationed to work up there. However, Europe's Hermes shuttle will never be able to dock on the complex.

The ESA's savings efforts in the past were limited, successes even more limited. "But there is still something there." Thus Federal Research Minister Dr. Heinz Riesenhuber states his more than doubtful hope of still being able to negotiate an acceptable financial framework before the ministerial council meeting in November in Munich. The cost increases are immense, particularly in the case of the Hermes shuttle, but also in the space station program at DM8.4 billion instead of the originally planned DM7.6 billion, the figures come out 10.2 percent higher. And this is true even though the Columbus element—parallel to the reductions in the US primary station Freedom—has already had to be significantly downsized.

This has become quite obvious with the docked space lab APM, a pipe stuffed with technology, which will weigh approximately 17 metric tons upon launch with the space shuttle. The length has been reduced by 20 percent to approximately 11.4 meters, so that now only eight instead of the original 10 double racks for the experiments fit in next to each other. There is room for a total of 21 double racks since not only the two sides of the APM lab, but also its ceiling are used. In the weightlessness of space, up and down lose their significance.

At the prime industrial contractor MBB-ERNO, one of the companies of the German Aerospace Agency (DASA), they would have gone even farther. "We advised the ESA to reduce the APM lab by 40 percent," explains project director Dr. Udo Pollvogt to the FLUG REVUE. "That would have opened up the possibility to develop the second Columbus space element, the free flying lab MTFF, largely according to the same design. According to our estimates, it would have thus been possible to save approximately 5 percent of the costs of the project." However, the proposal failed primarily because of the resistance of the Italians, who are developing the docked Columbus module at Alenia Spazio. However, the ESA justified the rejection with the rights of the Americans, who are to use half of the European lab for their experiments and would accordingly be affected by a reduction.

On the other hand, the structural similarity of the two space elements would have required a new ESA launch philosophy. Why? While the APM could have been downsized, something would have had to be added to the free flying MTFF which would, of course, have resulted

in a higher launch mass. Instead of being launched as a unit by Europe's own Ariane V, the lab part would have to be transported separately from the service segment with an additional shuttle flight. At least part of the cost advantage obtained with the development would have had to be spent for this. Additionally, the risk of the mission would have increased significantly through the rendezvous maneuver of the two components.

Additional cost reductions were only possible by cutting the fat from the catalog of services. Thus, on the APM there will be no airlock through which experiments can pass from the sealed lab into open space. It will possibly be added later. Perhaps it will be possible to share the systems of the Japanese which are going to be right in the vicinity of the Columbus APM in the node of the Freedom space station with their lab. At that point there is not only an external platform but also a robot arm with which the arrangement of experiments can subsequently be changed.

There were also reductions in the data management system and in the life support systems where now only those pollutants which are relevant to the safety of the astronauts will be measured in air and water. Furthermore, the ESA obtained a price reduction from industry because bids must no longer be made at fixed prices, but rather the contractor now shares certain developmental risks.

For the opposition in the German Bundestag, these measures are "slight of hand to hold the rates of increase down at least apparently." Edelgard Bulmahn, acting research policy spokeswoman of the SPD faction of the Bundestag, is particularly infuriated because in response to a "small question" from her party concerning space policy, she received "longwinded, meaningless statements." The politician wants a reasonable plan of use for the space station and sees her position justified by the current hesitating demand from companies and research institutes. An investigation by the German Aerospace Research Agency (DLR) serves to support this. It shows that with full utilization of both the docked lab and the free flying Columbus lab at the same time, approximately 1,200 teams of scientists would have to be employed to prepare, monitor, and evaluate the experiments in space. Therefore, the DLR comes to the conclusion in its analysis that it "is doubtful whether the existing scientific base in Europe is adequate to fully utilize two labs."

But it will perhaps not come to that anyway. Because, for the time being, parallel development of both space station elements is out of the question. The docked APM module quite clearly has priority. The Americans, who previously considered the labs from Europe and Japan more as safety risks and would only permit docking after the US primary station is completely equipped and permanently occupied by astronauts, are now doing an about-face. Because, as a result of NASA budget reductions, the Columbus-APM project is seen in a different

light. To permit use of the equipment for important materials experiments as soon as possible, the ESA lab is now already on the launch schedule for fall 1998—even before the US living module. By contrast, use of the free flying Columbus lab MTFF will be delayed by three to five years to 2002-2003. Only then—if ever—will the Hermes space shuttle be available and operational, on which the servicing and also the maintenance of the MTFF will then solely depend.

With this postponement, the development of the free flying Columbus lab would not begin until 1995-1996. This opens up a conceivable compromise for the ministerial council meeting in November: Hermes will, for the time being, be continued as an unmanned technology project, and a decision about the increased performance of Ariane V which is necessary for transporting astronauts can be made later at the same time as that for the Columbus MTFF in 1996. The federal government, which then will have the elections behind it, can decide by then whether it will stick with the Columbus element whose prime contractor is German. If no, as yet undiscovered, source of money has been found by that time, the MTFF will be canceled completely.

If the German delegation does not prevail with this strategy with the ESA, projects in the domestic space program must be toppled. Alternative candidates: The second German shuttle/spacelab mission D-2 or the hypersonic program, in which technologies for the completely reusable two-stage space transportation system Saenger II are being investigated. One would be as bad as the other: The spacelab mission must be interpreted as important practice for the space station, and Saenger was supposed to be the unquestionable flagship of German technology.

France: Space-Environment Test Facility Nearing Completion

92AN0059 Toulouse LA LETTRE DU CNES in French 1 Sep 91 p 2

[Text] The increase in satellites' weight and size, related to the capacity of the Ariane-4 and, soon, the Ariane-5 launchers, has led the National Center for Space Studies (CNES) and its subsidiary, Intespace, to begin, less than a year ago, to build a large, 700-cubic-meter test chamber, 10 meters in diameter, for testing satellites in the vacuum and temperature conditions of space (10^{-6} Torr, 100 degrees Kelvin).

The project, carried out with the financial support of local communities (Midi-Pyrenees region, General Council of Haute-Garonne, and the Toulouse City Council), is already in a very advanced stage:

The building that will house the new chamber is being built at the Toulouse Space Center. It will consist of a large, 16-meter-tall hall to prepare the satellites before introducing them into the simulator;

The vacuum chamber's various elements have been welded together, constituting a huge stainless-steel cylindrical reservoir, into which 7.5-meter-tall satellites can be placed for tests. After the chamber's transfer to its definitive place inside the building, the pumping equipment, a cryogenic generator, and a complex electronic control and measurement system will be installed.

Placed under the prime contractorship of CNES and Intespace, most of the program's work has been subcontracted to firms established in the Toulouse region:

The CGEM, MTS, and Fontainie companies for the laboratory and its air-conditioning and energy facilities (architect: Cabinet Glenat);

The Air Liquide company for pumping and cryogenic equipment;

Various firms, including Sodatec and Intespace's engineering department, for monitoring, control, and measurement systems.

This test facility, called Environment Simulation and Control (SIMMER), will be put into operation in early 1992. It will reinforce the position as European leader of the Toulouse testing complex run by Intespace.

German Aerospace Institute Produces High-Temperature Ceramics

92MI0085 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 23 Oct 91 p 7

[Text] It is well known that when space vehicles return from outer space they are exposed to enormous frictional heat on re-entry into the atmosphere. Scientists are therefore working on constant improvements to materials that withstand this heat. The German Aerospace Research Institute (DLR) has now brought into service two kilns that produce what are known as fiber-reinforced ceramics for use at high temperatures. These fiber-reinforced ceramics are ideal materials for space transport systems as they are very light and withstand high temperatures, thus meeting the high standards required of them. Fiber-reinforced ceramics consist of carbon or ceramic fibers embedded in an oxidation-proof silicon carbide (SiC) matrix.

The liquid silication process developed at the DLR Institute of Building and Construction Research produces the material more quickly and cost effectively than the process generally used to date. The components are first molded, then the matrix is fired. Pure silicon is added in the silication kiln at temperatures of around 1,500° and this reacts with part of the matrix to form SiC. The fiber-reinforced ceramics thus produced withstand temperatures up to 1,800° and are promising candidates for use in thermal protection systems and/or areas that become extremely hot in future space transport systems, such as Hermes and Saenger.

German Aerospace Institute Chairman Discusses Consequences of Budget Cuts

92MI0139 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 13 Nov 91 pp 4-5

[Text] The German Aerospace Research Institute (DLR) is making an urgent appeal to the political decision-makers not to jeopardize the productivity of research institutes through cuts in funding. Prof. Walter Kroell, Board Chairman of the DLR, said at the annual press conference in Cologne that, in view of the structural problems faced by the united Germany, care should be taken to ensure that the Federal Republic maintained its leading international position as an exporter of high technology; major research created an essential premise in this respect.

As examples, he took three current DLR research projects of international interest that epitomize "major research specific" productivity within the context of state forward planning policy:

"Flying simulators" are used to "test fly" aircraft that are still on the drawing board.

This is done with the most modern on-board computers, which can "convert" the DLR test aircraft into prototypes of future commercial aircraft, helicopters, or even space shuttles. It is not only time and money that are saved by using this "flying simulator" in the initial stages of industrial development: Safety and efficiency are also increased. The DLR flight test carriers are unique in Europe and are the result of years of intensive research and technological development.

"ROTEX" is a robot arm, that will be used for the first time on the D-2 mission, it has attracted international interest because its gripper is the most modern in the world.

A stereo camera enables the grippers, which are fitted with sensors of the highest precision, to "see" three-dimensionally. This is essential for the robot arm to be able to grip securely in space, even with a four-second time lag—the time it takes for the signal to travel between the earth and the orbiting laboratory. This project is an example of the technological exploitation of the potential interest in automation, robotics, and telescience for space purposes.

DLR scientists are researching the structure of combustion processes jointly with universities and industry.

Flame models are being developed and verified using the most advanced laser diagnostics. On this basis, carburetion, ignition procedures, and flame propagation can be optimized and the noxious emissions resulting from fossil fuel combustion are significantly reduced. Knowledge from aerospace engineering can thus be used to develop and improve combustion plants in all areas of application.

Germany: Development of Travelpilot Navigation System Discussed

92WS0097A Berlin RADIO FERNSEHEN ELECTRONIK in German Oct 91 pp 592-593

[Excerpts from a report by Dr. Wadym Suchowerskij, Robert Bosch GmbH: "News About Travelpilot"; first paragraph is RADIO FERNSEHEN ELECTRONIK introduction]

[Text] In the media and at numerous trade fairs, Travelpilot has attracted considerable attention. To date those mentioned as the most likely to be interested have been innovation hungry consumers and professional users. Even the authorized specialized dealers had to first get used to such an absolutely new system as Travelpilot. The articles give an overview of the current level of development of Travelpilot and its possible future use.

Travelpilot hit the market two years ago: It is a navigation system which displays for a driver a section of a street map on which he can find his current location, the distance and direction to his destination, and finally the location of his destination on the map. This map is always oriented such that the street in the direction of travel is displayed running toward the top of the screen. The position of the vehicle remains fixed; during driving it is the map that moves rather than the location of the vehicle on the display. The sector of the map displayed can be selected in nine steps between 200 m and 50 km.

Thanks to initial experiences, it has been possible to eliminate some childhood illnesses and to even add a few improvements. The digital map has been corrected, expanded, and updated with considerable effort.

New Street Map on CD

A year after introduction in Germany, Bosch entered the market in the Netherlands. There, all public streets and roads are digitalized. Only the street names still have to be added in the smaller communities. The political changes here at home have led to the gradual digitalization this year of the new federal laender. In 1992 the preliminary work will be completed for France; this will be followed by Belgium and Luxembourg.

Travelpilot has also been on the market in the USA since the beginning of this year. The first CD includes the urban areas of the west coast: San Francisco, Los Angeles, San Diego, Las Vegas, and even Honolulu. Four more CD's will cover the Midwest, the Southeast, and the South. American CD's also include the entire highway network of the United States.

The progress in the digitalization of street maps will be illustrated in greater detail using the example of Germany: In 1989 the street information of 84 large and middle-sized cities was available. By the 1991 International Radio Fair, the number will be 114. In the new federal laender, Berlin and its surroundings within the autobahn perimeter as well as metropolitan Dresden and

Leipzig are already included. The total length of the digitalized street network will climb from 290,000 to approximately 380,000 km, primarily through the inter-city street network of the new federal laender. Approximately 40,000 towns and 2,000 autobahn junctions will be selectable as destinations, and approximately 180,000 street names will be stored on CD. Within a year, all the inner-city street networks of all the large cities in the former GDR will be available.

New Functions

Constant advances are being made not only in digitalization, but innovations in the functions of the Travelpilot are also being added. The user can select among four languages, namely, German, English, French, and Dutch. He even has the choice between British and American English. Distance data can be displayed selectively either in miles or kilometers. The street name lettering can be in two different selectable font sizes.

The so-called standby period can be freely set in minute intervals. All data remain in active memory for this amount of time after the ignition is switched off. When the engine is restarted within the standby period, the last map image displayed reappears immediately. Program and map data do not have to be reloaded from the CD.

In the 3-km to 5-km scale, the names of autobahn exits (or merging points and intersections) are also displayed for improved orientation. And, finally, on demand a map of the region around the destination can be displayed.

Satellite Positioning With GPS

Despite all the refinements of the positioning process, it is possible for the Travelpilot to lose its orientation because of external influences. This may occur after relatively long periods of travel in non-digitalized regions or with driving on new by-passes or sections of autobahns. Loss of positioning must also be reckoned with after relatively long trips in not yet digitalized foreign areas. This also always occurs after transporting the vehicle by ferry or autotrain. The reorientation required in this instance is as simple as entering a new destination, but some users will consider it a nuisance. As a user-friendly solution to this problem, Bosch offers a receiver for the satellite positioning system GPS (Global Positioning System) as an accessory.

GPS is operated by the American Pentagon and in its final form—approximately the end of 1992—it will include a total of 21 satellites, which circle the earth in six different orbits in approximately 12 hours each. The satellites continuously send their orbital data and a highly accurate time reference. If a visual connection exists with at least four of these satellites, using the orbital data and the time reference differences between the satellite signals, the receiver can determine its position according to geographic longitude and latitude as well as altitude above mean sea level. With three satellites, two-dimensional position determination is possible, as long as the approximate altitude is known. The

accuracy obtainable for civilian applications is within the range of 20 to 50 m depending on the satellite configuration. Under unfavorable conditions, the deviation may be as great as 200 m.

The 15 satellites currently in operation already enable virtually gap-free, two-dimensional positioning around the clock. However, this applies only to open country. Shadows from buildings, trees, or hills frequently prevent the required visual connection with the satellites and, consequently, positioning with GPS. Therefore, for navigation in urban areas or in difficult terrain, satellite-independent positioning such as that with Travelpilot is indispensable. The GPS receiver must thus be considered merely an additional sensor.

The GPS receiver is connected to the Travelpilot via a mass-produced serial interface. A special software module detects the presence of the receiver and continuously polls its positioning results. In the event of implausibly large deviations between the GPS and the Travelpilot, the GPS positioning is calculated as a function of various limiting conditions. If the vehicle is in a digitalized area, the position is carefully brought to the corresponding position in the street network.

The GPS receiver has roughly the dimensions of a pack of cigarettes (168 mm x 142 mm x 26 mm). The antenna is no larger than a bar of soap at 70 mm x 70 mm x 20 mm and is attached by a magnetic base, preferably to the roof of the vehicle.

The GPS option will be deliverable beginning early in the summer of 1992. It offers the advantage that total loss of position can no longer occur. Upon returning from as yet undigitalized areas or after transporting the vehicle by ferry or autotrain, automatic resetting to the digitalized street network takes place.

Fleet Management

In the professional sector, Travelpilot is offered as a positioning component in fleet management systems. Via the above-mentioned serial interface, the current position of the vehicle can be polled at any time and transmitted with data concerning assignments or operational status to the headquarters of the fleet operator. The manager of operations or the dispatcher thus obtains continuously updated data concerning where available vehicles are actually located, where they are headed, with what load, or with what assignment.

In order to utilize fleet vehicles as efficiently as possible, the dispatcher needs a clear representation of the total situation. It is therefore reasonable to graphically present the current locations of the vehicles by colored symbols on a street map and to display them on a color monitor. The colors of the symbols indicate the assignment or operational status of the vehicles, e.g., "free," "in use," or "loading." With a click of a mouse, additional information could be called up, for example, concerning loading, crew, or assignment. It is also useful for the dispatcher to be able

to select map sectors and scales freely, for example, centered around the actual use location currently being processed. This is possible with the help of the street data base created for the Travepilot.

However, the Travepilot also offers additional capabilities: Written instructions for the driver may be transmitted by radio to the Travepilot, stored there, and displayed on the screen. Important data are not lost, even if the driver has temporarily left his vehicle. And what's more: The control keys of the Travepilot can be polled from the headquarters so that it is possible to carry on a dialogue with the driver without audio radio transmission. In this manner, the Travepilot becomes a mobile data terminal.

This provides all the essential elements for a fleet management system, with the Travepilot as a positioning component and mobile data terminal, wireless communications devices for connection with headquarters, and software components for displaying location. In many applications, additional system functions are required, such as logging all significant events or connections in the development of an assignment and bookkeeping in the commercial sector. Because requirements are very different depending on the application, off-the-shelf solutions will not be possible. Client-specific or at least sector-specific solutions will be the rule and will possibly be created in collaboration with sector-specific systems development firms.

AUTOMOTIVE INDUSTRY

France: Bioethanol, Diester Fuels Being Tested

92WS0143C Paris AFP SCIENCES in French
31 Oct 91 p 26

[Text] Paris—Vehicles are already running on diester, a rape seed-base fuel, in Clermont-Ferrand, Auch, and Rouen. Thanks to the petroleum tax exemption desired by the head of state, there may be a surge in the use of the two "green" fuels diester and bioethanol, thereby opening up new agricultural markets.

Diester and bioethanol are both derived from raw agricultural products and are currently being tested. Diester is made from vegetable oil (notably rape seed, but also sunflower and corn oil); bioethanol is produced by fermenting sugars extracted from sugar beets and grains. Regulations limit its share of fuel content to five percent.

Based on calculations made by the French Energy Management Agency (AFME), it would take 750,000 hectares of rape seed, or 4.2 percent of France's arable land, to produce the equivalent of five percent of gas oil consumption. "A scenario," according to the agency, "that is perfectly realistic." And manufacturing the equivalent of 5 percent of fuel consumption in bioethanol would require 450,000 hectares of wheat and sugar beets, or 2.5 percent of arable land.

The Federation of Oil- and Protein-Yielding Plant Producers (FOP) believes that the ultimate goal might be to produce 500,000 metric tons of diester, or 3 to 4 percent of annual gas oil consumption. The Ministry of Industry's Hydrocarbons Division (DHYCA) points out that sales of superfuel with 5 percent added ethanol are very weak and declining (2,500 cubic meters in 1989, compared to 1,600 cubic meters in 1990).

In France, buses and tractors have been running on diester in Auch (Gers) since June. An analogous experiment is underway in Clermont-Ferrand, involving both buses and garbage trucks. Five Rouen buses have also been operating on diester since 1 October. In Belgium, 15 experimental buses in Mons (southern Belgium) have been running on diester for a month.

According to the DHYCA, the cost of diester is currently about five francs [Fr] a liter (compared to Fr1.20 for a liter of gas oil) and the oil-products tax (TIPP) that was added to it until now was Fr0.41 a liter, making its net-of-VAT (value-added tax) retail price Fr5.41.

The cost of manufacturing a liter of ethanol averages Fr3.30 (compared to Fr1 for a liter of refined superfuel) and its TIPP is Fr1.63, resulting in a net-of-VAT price of Fr4.93.

According to an AFME study, the cost of making ethanol could be lowered to Fr2.80 a liter if done in 20,000 metric-ton-capacity factories, and to Fr2.40 using 100,000 metric-ton-capacity plants. The Compiègne factory that will be operational in a year will produce 20,000 metric tons annually.

The 1992 appropriations bill is expected to do away with the TIPP for diester and bioethanol fuels. If the deputies do decide to go ahead with this, the price of industrially-manufactured diester could drop to Fr3.41, compared to Fr2.63 for gas oil. Bioethanol's would be Fr3.30 against Fr4.15 for leaded superfuel, according to AFME.

France: Research on Thin Film Battery for Electric Car

92WS0123A Stockholm NY TEKNIK in Swedish
17 Oct 91 pp 22-25

[Article by Miki Agerberg: "Batteries by the Meter Pave the Way for Electric Cars"—first two paragraphs are NY TEKNIK introduction]

[Text] An entirely new type of battery is taking the step from development to mass production. Big companies and laboratories on three continents are fighting to be first.

"Thin film batteries will give the electric car its real breakthrough," creator Michel Armand said in an interview with NY TEKNIK.

Imagine an electric car that has the following characteristics:

It can travel 30 Swedish miles on one charge with a top speed of 130 km an hour and acceleration in a class with an ordinary small passenger car. It can be charged in two to three hours using a regular electrical outlet.

The battery weighs 200 kg, takes up twice as much space as a normal gas tank and is not much more expensive to manufacture than a conventional lead battery.

No, such an electric car does not yet exist. But it is on the way. A new type of battery, the thin film battery, is just about to take the step from development laboratories and pilot projects to the market.

Within a Few Years

Within a few years the first thin film batteries big enough to install in cars will arrive. Then we can expect to get electric cars with the performance just described; in a higher class than the best prototypes displayed at the Frankfurt Trade Fair in September (see NY TEKNIK 1991:38).

"Electric cars are the future of automobile driving because environmental requirements will become increasingly strict," Armand said.

"But if the electric car is to become an alternative for the common man it must have a decent top speed and range. That can never be achieved with lead batteries or nickel-cadmium batteries."

French Alps

I met Michel Armand in his laboratory which is located in the extensive green campus area of Grenoble in the French Alps. The laboratory specializes in electrochemistry and is part of the French state research organization CNRS [National Center for Scientific Research].

Today thin film batteries are a technical and political drama with big companies and agencies in the United States, Japan, Canada and Europe investing many millions to be first on the market.

But it was Michel Armand who started the whole thing.

"I began 20 years ago when I was still a student," he told us. "The goal was clear from the beginning: I wanted to find a more efficient way to store energy."

Battery technology is the big obstacle to the breakthrough of the electric car. And it is also important in a number of other areas to find batteries that can store more energy and generate more power than those that exist today without being heavy and bulky.

Armand approached the problem in true French fashion. He began by stating the question theoretically: What should the ideal battery look like?

The negative pole was easiest. Lithium was the obvious choice. Then it was a question of finding a substance that was good at trapping lithium ions.

Special Crystal Structure

The answer was a type of compound with a special crystal structure that enables it to store both lithium ions and electrons and return them when the battery is charged (for example vanadium oxide or titanium disulfide).

Then came the hardest part: the electrolyte.

"I wanted to have a dry electrolyte, not a liquid one as in ordinary batteries," Armand said.

A British researcher had discovered that polyethylene oxide is a plastic with unusual properties: it can conduct ions. Michel Armand began experimenting with it, modified it and found that it worked. In 1978 he took out his first patent on a polymeric electrolyte.

Voila! The cornerstone of the new battery was in place. The rest is technology: thin film technology. The plastic is a poorer conductor than fluid electrolytes and this is compensated for by reducing the distance between the poles.

The result was a battery that consists of four thin layers, altogether not much thicker than a piece of ordinary writing paper (see sketch [not reproduced; see caption below]).

It can be manufactured by the meter in about the same way as plastic film or video tape and is folded or rolled to the desired size and form.

Therefore in principle batteries of this type can be used to run everything from minicalculators to automobiles.

The first prototypes of Armand's thin film battery were produced 10 years ago. Most of the technical development work is done by the Canadian Hydro-Quebec power company which became involved in the project at an early stage.

Today prototypes as big as a tea caddy (containing many square meters of battery film) have been built and tested. The test results have gradually improved to a point where the companies involved have now decided to move on to mass production.

In Canada a factory with the capacity for manufacturing the large amounts of battery film needed for car batteries is under construction. They will be ready to start testing the first full-size car batteries by the end of next year and the goal is to mass produce car batteries in 1995.

At the same time a factory for smaller batteries is being built in Japan by Yuasa, a big Japanese battery firm that has stepped in as a joint partner. It plans to get started on mass production in 1992-93.

Two competitive research groups associated with other big companies have also come a long way with batteries of a type similar to Armand's.

Innocell in Odense, which was formed by a Danish innovative company and a battery manufacturer from the United States, hopes to have small thin film batteries for mobile telephones and wireless tools on the market in just half a year.

Thus there are many indications that thin film batteries will make their breakthrough in the 1990's. What makes them so attractive?

There are two decisive characteristics for an electric car battery: how much energy it can store (this determines the car's range) and how much power it can provide (this determines the car's top speed).

The diagram [not reproduced] shows typical figures for different types of battery. Both lead batteries, which are the most common in electric cars today, and the more expensive nickel-cadmium batteries have severe limitations with regard to both top speed and range.

Performance Too Poor

"An electric car with this kind of battery will never be able to reach a decent performance level," said Michel Armand. "That is because it requires an energy density of at least 100 Wh/kg and at the same time an effect density of at least 100 W/kg.

"Lead batteries have only achieved 35 Wh/kg and nickel-cadmium batteries 50 Wh/kg. The latest thin film batteries, on the other hand, have demonstrated an energy density of over 150 Wh/kg in experiments."

At the same time they have succeeded in extending the life of thin film batteries so they can now survive over 1,000 charges.

Armand thinks electric cars with lead batteries will never be attractive to ordinary people. He believes nickel-cadmium batteries will be banned for environmental reasons.

Instead he views sodium-sulfur batteries, which are manufactured by ABB [Asea Brown Boveri] among others and were used in several of the electric car prototypes at the Frankfurt Trade Fair, as the toughest competitor to thin film batteries. Their performance is almost as good as that of thin film batteries.

But they have two drawbacks, Armand said: safety and price.

"An NaS battery must be kept heated to 350°C at all times. This involves both unwieldy technology and safety risks."

It is true that a car battery of the Armand model also needs to be heated, but only to around 50°C. There is no risk of gas formation and explosion. And it will be

cheaper, Armand said that it is estimated that a car battery will cost around 20,000 kronor.

But he conceded that sodium-sulfur batteries have a time advantage.

"They are not as good as thin film batteries but they may still come out before we are ready."

Other researchers at NY TEKNIK think that thin film batteries will reduce the lead. Several see a future for both types of battery. Thin film batteries as small mobile batteries, sodium-sulfur batteries as heavy stationary power packs.

What the future will look like is not just a question of research and technical development. It is also a question of industrial policy.

The thin film batteries have their origin in Europe. But ironically it is on other continents that people are putting the most emphasis on them.

Oil Company Backed Out

The French oil company Elf was involved in Armand's project but backed out in 1986 when the firm decided it could not produce profits quickly enough. The Canadians were forced to look for another partner and that is how the Japanese became involved.

The other two European research groups in Denmark and Great Britain are cooperating with big firms from the United States.

U.S. Advanced Battery Consortium, an association of auto companies, battery firms and agencies that was formed in the United States to produce electric car batteries quickly, has decided to allocate 15 percent of its annual budget to thin film batteries (the equivalent of around a hundred million kronor). Miti, the powerful Japanese industrial ministry, has also decided to make a substantial investment.

"The tough environmental requirements in Los Angeles are speeding up development," Armand said. "The United States will be the first big market for electric cars."

Stunned and Anxious

He continues to combine polymers and experiment with composites in his laboratory in Grenoble in an attempt to create thin film batteries with new properties.

In Europe agencies and big firms are stunned and anxious about this technology which originated in a French state laboratory and is slipping out of their grasp. Michel Armand regrets that they did not see the possibilities earlier, but feels it is not too late:

"Thin film batteries will be big all over the world," he said. "We will see many regroupings and new constellations of companies in the next few years."

Caption

1. p. 22: The thin film battery is totally dry and not much thicker than a sheet of ordinary writing paper, around 0.2 mm. It consists of three thin layers: lithium, a polymer that serves as electrolyte and a composite that is a combination of electrolyte and a compound that is good at trapping lithium ions (for example vanadium oxide). A fourth layer serves as conductor.

Lithium ions pass through the electrolyte to the composite, while the electrons from the lithium layer take the outer route to the composite via the conductor. Both ions and electrons are stored in the composite and pass back to the lithium layer when the battery is charged.

France: ICI Develops Ethanol Additive

92WS0124A Paris L'USINE NOUVELLE
TECHNOLOGIES in French 17 Oct 91 p 16

[Article by Michel Vilnat: "Diesel Goes Alcohol"; L'USINE NOUVELLE TECHNOLOGIES introduction is: "Avocet, an additive developed by ICI (Intellectual Cooperation Institute), enables diesel-engine buses in Tours to run on ethanol."]

[Text] Black exhaust and gas oil smells are vanishing from downtown Tours. Semitrat, a bus operating company, altered four of its vehicles to run on ethanol in collaboration with ICI and Moteurgaro. Ethanol is a much less polluting fuel than gas oil: It produces one-third as much CO, one and a half times less HC and NOx, and practically no soot. It contains no sulfur or lead at all.

What makes the experiment original is the type of engine—diesel—that is being used. For alcohol has a very low cetane index, making it very poorly suited to diesel engines. To correct this, ICI developed a nitrated-ester-base additive dubbed Avocet. Mixing it with ethanol so that the additive makes up 3.8 percent of the fuel content allows compression ignition. Moreover, the entire fuel system, from the tank to the injectors, was modified by Moteurgaro Company to offset ethanol's lower calorific value. A specific surface treatment was also applied, to prevent choking and guarantee engine longevity.

Total cost of the transformations is 40,000 French francs [Fr]. The figure bears comparison to the cost of the RATP's (Independent Parisian Transportation Board) pyrolytic pot, which exceeds Fr100,000! The only fly in the ointment is the fuel's price, which is two and a half times greater than that of gas oil. According to Moteurgaro specialists, however, it should be possible in the future to build a less thirsty ethanol-diesel engine.

Peugeot Unveils Electric Car Prototype

92WS0111C Paris AFP SCIENCES in French
17 Oct 91 pp 57, 58

[Article: "PSA Introduces New Electric Vehicles"]

[Text] Paris—The PSA group (Peugeot) on 14 October introduced two new electric vehicles—a small car and a motor scooter—as part of a forward-looking industrial strategy aimed at better integration of individual transport with the urban environment.

The car, called "Citela" (City Electric Automobile), is a prototype introduced under the Citroen label. Qualifying as a "zero-pollution" vehicle under California standards, it can travel 210 km at a speed of 40 km per hour without recharging, or 110 km per hour [as printed] in downtown "stop-and-go" traffic, which uses up a great deal of energy.

Its top speed is 110 km per hour, which means a motorist can drive for extended periods on boulevards on the outskirts of Paris at a constant speed of about 80 km per hour without consuming too much energy. This small vehicle—2.96 meters long by 1.55 wide—takes six hours to recharge. If the battery runs down, it can travel an additional 10 kilometers on a 20-minute charge.

One of the prototype's unique features is its "flat-bed" frame, on which three different bodies can be installed in a few minutes' time: a so-called winter body, an open-roofed body for summer, and a third that turns it into a small, light utility vehicle with an enclosed cab and a sort of rear cargo hold that is not protected against the weather.

Mr. Jean-Yves Helmer, manager of PSA group's automobile division, says PSA hopes to move quickly to market such electric cars—without batteries—for the price of a traditional vehicle of comparable power.

Of course, the cost of batteries will not be negligible: They may sell for something like 12,000 French francs. But electricity will cost only about one-sixth as much as traditional fuel, and the motors will have exceptionally long life: An electric motor should be able to go for a million kilometers without problems, and a nickel-cadmium battery should last for about a decade.

Also introduced was an electric scooter developed by Peugeot Motocycles. With performance comparable to that of a traditional (50-cc) scooter, this easily rechargeable two-wheeler has a range of 40 km per hour [as printed] and might initially be sold to companies.

French City to Receive Electric Car Traffic in 1993

92WS0111D Paris AFP SCIENCES in French
17 Oct 91 p 58

[Article by: "Peugeot and Citroen Electric Vehicles in La Rochelle in 1993"]

[Text] Electric cars meant for the general public will be on the streets of La Rochelle starting in the second half of 1993, thanks to an agreement between the municipality, EDF [French Power Company] and PSA (maker of Peugeot and Citroen), PSA announced on 10 October.

The automobile group will provide 50 electric-powered Citroen-AX's and Peugeot 106's, while EDF will install and maintain recharge terminals at about 40 parking lots and service stations. The city of La Rochelle will help with installation of the terminals.

According to PSA, this test, which will make La Rochelle "the first city in the world" equipped for such vehicles, will facilitate a study of "driver behavior, reactions of other users, battery recharge requirements, and the impact of electric cars on the urban environment."

Depending on the initial results of the experiment, the number of electric 106's and AX's made available to La Rochelle residents will "gradually be increased to 2-300," PSA indicated.

French Car Fueled by Household-Waste Methane

92WS0111E Paris AFP SCIENCES in French
17 Oct 91 pp 58, 59

[Article: "First Vehicles Propelled by Fuel Made from Household Waste"]

[Text] Montech—The first cars powered by fuel made from household waste were introduced on 15 October by the Drimm company (based in Montech near Montauban), an outfit that specializes in household waste treatment. "Drimm is the first French company to convert waste biogas into methane—the cleanest fuel in existence—for vehicle operation," explained Mr. Robert Droux, president and general manager, during an open-house at the site.

When it decomposes, the organic waste releases a gas composed mainly of methane and carbon dioxide, fermentation of which produces the methane equivalent of 2.5 tonnes of oil per day [as printed]. To produce the methane fuel, Drimm collaborated with Solagro—a Toulouse-based association promoting innovative solutions in the field of energy, agriculture and the environment—which participated in development of a gas purification and compression system.

The biogas can also be used to provide steam, heat and electricity. Drimm plans in the near future to build a sorting and recycling station for waste (plastic articles, scrap iron, cardboard boxes, and wooden pallets) that runs on electricity produced from biogas at the plant.

Finally, Drimm now has an experimental container-assayer that analyzes waste contents and verifies that the waste received is not mixed with toxic substances. The company, which has about a dozen employees, processes about 150,000 tonnes of waste per year.

France: Availability of Electronic Clutch by 1992 Discussed

92WS0112C Paris LES ECHOS in French
21 Oct 91 p 28

[Article: "Goodbye to Clutch Pedal"]

[Text] By the year 2000, the world market for electronic clutches will be equal to about 15 percent of the market for manual transmissions, according to officials at Valeo, which is launching this innovation into competition against Britain's AP and Germany's Fichtel und Sachs.

Already in mass production at Ferrari Mondial T, the electronic clutch offers an alternative to standard or automatic transmissions. It definitely has advantages, since it eliminates the clutch pedal while allowing the driver to select the gears, which he or she cannot do with automatic transmission.

These features result from the miracles of electronics. A contactor installed in the stick detects the gear-shift and gives the disengage signal through an electronic module. Once the gear is shifted, a sensor signals and the transmission is re-engaged. The heart of the system is an electronic module that receives and integrates all information from the various sensors and sends commands to an electromechanical actuator.

When will this innovation be on the market? Officials at Valeo hope the electronic clutch, expected to cost between 3-4,000 French francs [Fr], will be mounted on an Alfa Romeo car in 1992, and negotiations are under way with two other builders for other applications.

Germany: AEG's Nickel-Chloride Battery to be Available by 1992

92WS0164A Duesseldorf VDI NACHRICHTEN
in German 01 Nov 91 p 34

[Unattributed Article: "Improved High-Energy Battery with a 20 Percent Increase in Power"]

[Text] Just recently, AEG [General Electric Company] presented a considerably improved version of the sodium/nickel-chloride high-energy battery. Compared to the previous generation, it boasts an increase in power of more than 20 percent. Samples are expected to become available in 1992.

AEG has developed this high-energy battery in cooperation with Anglo American Corporation and presented it to the public for the first time a year ago. The system uses sodium/nickel-chloride and has an energy density which is approximately four times higher than that of previous lead batteries. This makes the battery particularly suitable for powering vehicles. According to AEG, the developers have now succeeded in increasing the battery's energy content from 30 kWh to 35 kWh. This results in an increase in energy and output density: 130 Wh/kg—or in terms of volume—from 110 Wh/l to 170 Wh/l; power density increased from 110 Wh/kg up to 170 Wh/kg (depending on battery charge). AEG expects that the battery life will be the same as that of the current model, i.e. more than 1,000 cycles which is equivalent to 150,000 passenger car miles and a five-year life.

According to the company, the improvements were made possible by changing the cell and battery design. Efficient use of the available volume and a reduction in weight are the primary factors contributing to the improved performance. Dr. Harald Boehm, head of the high-energy division, expects further increases in output: "We are still far from having exhausted all technological possibilities of the system."

To demonstrate this technology in actual operation several electrically operated passenger cars (Mercedes-Benz 190) have been equipped with sodium/nickel-chloride batteries and undergone specific testing in city and short-distance traffic. Even with a vehicle weight of more than 150 kg, one battery charge (test model, 30 kWh) lasted up to 175 km (city driving: 130 km) with a maximum speed of 130 km/h and a hill climbing ability of more than 30 percent. Boehm expects the new battery generation to cover in excess of 200 km on one charge.

Germany: Battery Production Costs, Low Storage Capacity Delay Electric Car

*92WS0064C Duesseldorf VDI NACHRICHTEN
in German 4 Oct 91 p 36*

[Article by Rainer Hofmann: "Long Way to Light Energy Storage; Development of Batteries Slows Down Electric Car"; first paragraph is VDI NACHRICHTEN introduction]

[Text] Duesseldorf, VDI-N, 4 Oct 91—The new batteries provide unsatisfactory capacity and cost too much to produce. Experts estimate that there will, in the future, be a greater demand for alternative engines, in part forced by coercive environmental policy measures. Therefore, scarcely any mass-production manufacturer will no longer deliberately fail to appear at international auto shows without presenting an electric-powered vehicle. Nevertheless, really serviceable products at acceptable prices are pretty much commodities in short supply.

The idea of an electric-powered vehicle is almost as old as the automobile itself. As early as the start of this century, the "Columbia" or a Renault model were being driven with electric power. Still, while the carburetor engine has been constantly improved and perfected, the weaknesses of the electric car concept have remained nearly the same to this day: too heavy, too slow, too short a range.

Nevertheless, a growing volume of pollutants, especially in densely populated areas, is creating a "need for action," as it is called in politicians' jargon. This has led to, for example, the demand for "zero emission vehicles" (ZEV), which should prevent smog within a few years in Los Angeles. But in our country too, politicians are already thinking of banning vehicles with combustion engines from inner cities.

At the present time, manufacturers are meeting the call for alternatively powered vehicles with three different design types. Someday "comfortable motor scooters" (the O-tone of one manufacturer) and "golf cars" will be displayed on sales floors. They are on the whole severely limited in range and performance, but they do have one important advantage: They can be bought at any time and for reasonable prices, up to about DM15,000.

Both of these attributes are valid in only a very limited way for the second category of today's electric vehicles, chiefly produced by mass-production manufacturers. Openly based on the principle: "you take an available body and install an electric motor in it," a whole series of models that were originally designed for a carburetor engine and had been reequipped with electric motors were on display at, for example, the International Auto Show in Frankfurt. According to the unanimous statements of the manufacturers, they are a short or medium-term solutions since only the third design type, namely vehicles specifically built for electric operation, has a real future. However, so far they exist only as prototypes, still years away from mass production.

Batteries with their limited capacity are still the biggest problem for all manufacturers of electric cars. Although lead (Pb) batteries are tried and true and of good value, despite numerous improvements—for example, electrodes made of fiber sheets instead of massive metal or gel electrolytes—they are still too heavy compared with the storable energy. Nickel-cadmium (Ni/Cad) batteries have produced an improvement of this ratio. In addition, they have the advantage of being quickly rechargeable, but are substantially more expensive than the lead competition.

High-energy batteries with ABB [Asea Brown Boveri] sodium-sulphur (Na/S) or AEG sodium nickel-chloride (NaNiCl₂) electrodes represent the summit of what can be technically produced today. They work at temperatures of about 300°C, which calls for a high structural cost. But since these types are only now coming out of the laboratory phase, prices for a passenger car come to several tens of thousands of German marks.

But weighing the same, they store from four to five times as much electrical energy as conventional lead batteries. However, Dr. Cord-Henrich Dustmann, the marketing director of the ABB High-Energy Company, is of the opinion that, now that this technology has been studied for years, it is to be expected that it will be introduced into the market in three to four years.

Roland Ehm, the manager of the advertising department for business sector optical and vacuum technology of AEG, which also belongs to Daimler-Benz, believes that, as of about 1995, it will be able to produce about 15,000 Na/NiCl₂ batteries. Then, a price of about DM300 per kWh, which compares with that of a lead battery, may be possible, he told VDI NACHRICHTEN. Mercedes-Benz is also testing this battery. Installed in a Model 190, two

Na/NiCl₂ batteries permit a driving distance of 130 km for a 1.6-ton passenger car, a noteworthy figure.

But for a short time, we are offered a switch of equipment to smaller and therefore chiefly lighter vehicles with lead batteries. However, a Fiat Panda with its "lead tank" comprising 172 AH already weighs over 1.1 tonnes empty. It remains doubtful whether a price of over DM30,000 for this simple model with its very modest performance will find any friends, except for local use.

VW engineers are now promoting a bigger technical effort. They are mounting a hybrid engine on the Golf as well as including it in the blueprints for the Chico compact car. An electric motor provides the motive power for short inner-city distances and a combustion engine provides for greater range and speed, it being all the same whether it operates on the gasoline or diesel principle.

But the hybrid concept also allows for other interpretations. At Peugeot the turbodiesel also serves exclusively during highway operation to drive a generator, which then supplies two electric motors directly connected to the rear wheels via a Ni/Cad battery with power. The emissions and efficiency of the diesel engine running at a constant RPM can be quite easily adjusted to optimal performance.

Audi, on the other hand, completely separates the combustion engine from the electric motor. Alongside the conventional engine, the Audi 100 Duo has an electric system that is completely independent of it. An Na/S high-energy battery permits approximately 80-km-long runs at about 60 km/h. The water-cooled, three-phase-current synchronized motor drives the rear wheels with 21 kW.

In the long run, however, electric cars will only have a chance as a real alternative if they are consistently built in accordance with what they are designated for. Displayed for the first time in public at the 1991 International Auto Show, the BMW E1 is such a car, as well as the VWChico, both of them, of course, pure prototypes. It would take at least another four years before mass production is possible, provided that the decision is made now, a BMW technician thought.

More consistent light construction gets the weight of the E1 down to barely 900 kg and the Na/S battery allows for a maximal driving distance of 250 km, of course, only if the top speed of 120 km/h is not constantly maintained. While BMW itself describes this study as an alternative for the future, another development, the LA 301, should already be a reality in barely two years.

Its very name is an indication of its primary market: Southern California, Los Angeles. The manufacturer is the Swedish-British consortium, Clean Air, with its main office in Stockholm and which developed this hybrid vehicle in only three years. By 1996, they should be selling 35,000 of these \$30,000 cars a year.

A 42-kW electric motor in conjunction with a two-gear automatic transmission provides the motive power. In order for the plastic egg not to grind to a halt after 80 km, the Swedes have mounted on it a "range extender," as the little 25-kW carburetor engine is referred to at Clean Air. It also operates through the automatic transmission and, electronically controlled, only cuts in at higher speeds, taking the LA 301 to a distance of more than 240 km.

In what form electric cars will in the future be operating on our gridlocked streets will no doubt depend on the time that it takes to develop them. In any event, one thing is certain, and not only for Audi expert Manfred Dietrich: "No battery with a much higher concentration of energy than the present Na/S or Na/NiCl₂ types will any longer be developed in this century." Only a real technological leap could produce distinct improvements in connection with this. How much larger a lead conventional fuel still has over [battery power] is shown by a comparison of energy content in relation to volume. Gasoline contains the equivalent of about 10,000 Wh per liter; the best batteries produce a maximum of 170 Wh per liter, that is, about 60 times less energy.

Germany Promotes Environmentally Safe Transport R&D

*92MI0117 Bonn TECHNOLOGIE-NACHRICHTEN
MANAGEMENT-INFORMATIONEN in German
28 Oct 91 pp 9-10*

[Text] The term "ecocar" covers a variety of ideas using a variety of technical approaches and combinations of approaches with the aim of making the car less damaging to the environment. These approaches range from optimized or alternative drive systems to a longer life, reduced weight and recyclability of the bodywork, and improved roadworthiness. These notions are being further developed largely as a result of increasingly heated competition for innovation in the motor industry, which is given constant impetus by state regulations and the buyers' growing environmental awareness, said BMFT [Federal Ministry of Research and Technology] Parliamentary State Secretary Bernd Neumann in answer to a parliamentary question. Nevertheless, Neumann went on, the BMFT was promoting selected technologies that aimed at producing an environmentally safe car, in order to support its development with well-directed inducements. He mentioned in particular:

Support for the development and testing of an ecocar in the form of a standard small vehicle (Eco-Polo). In the initial period from 1 January 1984 to 31 December 1986, this project had funded the development of a compact car to the tune of around 1.9 million German marks [DM]. In a subsequent stage running from 1 September 1986 to 31 March 1992, this particularly low-consumption, low-pollution, and low-noise engine design is undergoing field trials. About 50 of these cars are now being tried in normal traffic conditions, mainly in the city zone of Berlin. The Federal Minister of

Research and Technology has allocated roughly a further DM2 million for this trial. The project is also receiving financial support from the Berlin Senate. The main objective of the project is to reduce the Eco-Polo's consumption in city driving to around 3 l/100km. Although the tests are still incomplete, it can be said that the target is at least close to being reached.

Funding for methane technology (including research on ethanol): 1974-1989 BMFT funding approximately DM92 million.

Rapeseed oil as a fuel for diesel engines: 1988-1991 BMFT funding approximately DM5 million.

A further project on the development of a direct injection rapeseed oil engine is being given approximately DM1.9 million funding in effect since 1991. The BMFT's "regenerative raw materials" program also includes other funding measures connected with rapeseed oil, such as DM0.9 million for a study to define a standard for the fuel "rapeseed oil methyl ester."

Support for hydrogen technology: 1974-1989 BMFT funding approximately DM41 million.

A commercial vehicle project with high-pressure storage is receiving funding of approximately DM5.5 million under the BMFT's "Renewable Energies" program since 1990.

Funding for the development of electric vehicles (vans and buses): 1974-1989 BMFT funding approximately DM45 million.

The "Renewable Energies" program has so far allocated more than DM100 million for the development of new batteries, in particular the sodium-sulphur battery. This program is also funding other projects on the development of batteries and fuel cells.

With an eye to the threatening greenhouse effect, the BMFT has also commissioned a study into the possibility of using solar electricity to power electric vehicles.

New Audi Model to Use VW Directly Fuel-Injected Diesel Engine

92WS0115A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 28 Oct 91 p 10

[Article by sel.: "Computer-Controlled Engine Management—Low Exhaust Gas Emissions and Noises—Optimized Coolant Circuits"]

[Text] Aachen. For the first time, the directly fuel-injected 1.9-lit diesel engines, made by VW (model year 1992), is to be used for the series-produced Audi 80. The engine has an output of 66 kw. Along with the 2.5 TDI, by Audi, it meets the exhaust gas limits for the first time for a passenger car with a diesel engine with directly fuel-injected combustion process. It features a third-mix

consumption of 5 lit for a distance of 100 km and thus represents an economical, efficient engine with little exhaust gas generation.

It achieves its output by means of the optimization of the directly fuel-injected process (swirl, piston pan, injection equipment) and by means of the use of Electronic Diesel Control (EDC) for engine management. A fume limiter permits smoke-free operation under the most varied operating conditions. Injection start regulation, regulated exhaust gas return, and a diesel catalyst are used to reduce the noxious substances. The charge pressure regulation with elevation adaptation supplies the engine with an extensively constant air mass independent of the temperature and the elevations.

Modern diesel engines are expected to have an above-average service life. Engineers Rhode, Guekesme, Liang, and Schmitt of Volkswagen AG, Wolfsburg, presented the engine during the 3rd Aachen Conference on Vehicle and Engine Technology which was held under the direction of professors Pischinger and Helling.

Basic experiments on two-cylinder engines, as regards the emission, demonstrated the superiority of the five-perforation nozzles as against the four-perforation nozzles, especially in the lower to middle characteristic field range. This is why an injection nozzle with five perforations was used in order to further tune the combustion process in the 1.9-lit engine. The optimum development of the swirl duct, adapted to the engine, represented an essential main point in development.

The VP 34 electrically controllable distributor injection pump, in the VE4/10 version by Bosch, was used as injection pump. To achieve high feed rates that are necessary for good combustion in the lower charge and rpm range, it was necessary to provide reinforcement measures in the injection pump motor. The balanced pressure relief chosen here reportedly ensures a steady injection pressure in the entire engine operation range, in conjunction with the coordinated injection performances and the nozzle holders whose noxious space was minimized. Blowbacks and after-squirts would certainly be avoided in this fashion. The combination of single-spring holder with an injection hole nozzle, having a perforation diameter of five times 0.194 mm and an injection angle of 150° as the optimum, proved effective in the attainment of minimal emissions.

These demanding development goals could be attained only by using a computer-controlled engine management procedure. The choice fell on the EDC electronic diesel control, with the MSA 6 control unit, offered by Bosch. The required injection start value is preset as a function of the engine rpm and the fuel mass [weight] and is regulated via the clocked magnetic valve of the spray adjuster of the injection pump.

The relatively early start of injection at low rpm with full load is rather striking here and it facilitates operation with little fume generation. The engine is furthermore operated at medium rpm and small to medium-high

charge with very late injection start; this considerably reduces the generation of nitrogen oxide. For exhaust gas return, a required air mass value, depending on the rpm and the fuel mass, is compared to the actual value of the air volume meter and is then regulated.

The cylinder crank housing, developed for the 1.9-lit swirl chamber diesel engine, did not reliably withstand the high peak pressures that occur in the TDI motor. This is why strength-increasing measures were taken and critical points were reinforced by design measures (for example, by means of ribs).

The forged crankshaft of the engine requires precise maintenance of production tolerances, especially along the grooves of the shaft. It was only the introduction of the dressing rolling process during the production phase that ensured maximum possible durability. A torsion oscillation attenuator was used to reduce the crankshaft oscillations and the mass inertia moment of the flywheel was optimized.

The coolant circuits had to be optimized for the newly-developed light-metal cylinder head. Pressure and flow losses as well as critical dead water zones were investigated. Engine control is accomplished via toothed belts. But because stresses on the toothed belt on the 1.9-TDI motor are considerably higher, it was necessary to make additional changes to improve the running performance and to increase the service life. Now an automatic tension roller prevents the toothed belt from being overstretched. The belt tension is kept constant during all operating states. An additional steadying roller prevents transversal and torsion oscillations of the toothed belt between the cam shaft and the injection pump.

The operating procedure of the 1.9-lit diesel engine was developed with a view to low specific consumption, high torque, and high output with low soot emission. Little exhaust gas emission and a low noise level were also achieved. There were three measures that were taken here: the first reduction is performed in the combustion process by means of delay injection start and exhaust gas return. The analysis of the noise radiation from the cylinder crank housing led to design changes for series production. Finally, by means of part encapsulation and attenuation, it was possible to achieve a noise in the vehicle that can be compared to the engine noise of a higher-grade middle class car.

At a constant speed of 90 km/hr, the consumption values are 3.8 lit, at a speed of 120 km, the consumption comes to 5.2 lit, and in city traffic, it turns out to be 6.2 lit per 100 km. The vehicle offers a powerful, dynamic, and comfortable engine along with little noxious substance emission and very low fuel consumption.

BLICK DURCH DIE WIRTSCHAFT, 28 October 1991.

BIOTECHNOLOGY

French Researchers to Test Potential AIDS Vaccine in 1992

92WS0102B Paris *LE MONDE in French*
29 Oct 91 p 29

[Article: "France Will Soon Test Possible AIDS Vaccine"]

[Text] The daily journal *IMPACT MEDECIN* announced on Monday 28 October that an experimental vaccine against AIDS will be tested in France on 20 to 60 healthy volunteers during the first half of 1992. The tests will be conducted in the framework of an agreement between the Pasteur Institute and the Pasteur Merieux Serums and Vaccines company, under the aegis of the National Agency for AIDS Research (ANRS).

The vaccine used in the test will be composed of glycoproteins on the surface of the HIV virus. "This is not the vaccine of the future, because the vaccine just protects against one strain of the virus, while unfortunately, as we know, the AIDS virus varies enormously and there are very many strains of it in nature," said Mr. Maxime Schwartz, director of the Pasteur Institute in Paris.

Additional details about the upcoming experiment will be disclosed during the Cent Gardes seminar taking place 28-30 October at Marnes-la-Coquette, near Paris. The colloquium brings together most of the specialists who are working on a vaccine against the retrovirus.

France: Computer Modeling Software Used in Agricultural Management

92WS0078A Paris *LE NOUVEL ECONOMISTE*
in French 11 Oct 91 p 40

[Article by Genevieve Dupoux-Verneuil: "The Software That Makes Trees Grow"; *LE NOUVEL ECONOMISTE* introduction is "Computers capable of managing orchards"]

[Text] Computers are coming to the rescue of farmers. On the screen of researchers at the Montpellier International Research Center in Agronomy and Development (CIRAD), forests and orchards grow before your eyes. Their image-simulated growth hastens or slows depending on different parameters, from the amount of atmospheric humidity, to sunshine, pesticide effects, and the frequency of pruning. The objective of the inventors of this surprising vegetation-growth-modeling software program dubbed Amap is to improve crop management, not through the now-classic methods of artificial doping, but by heightening the intrinsic capacities of each species. The program cross-pollinates information of two sorts: the typical growth of different varieties, which is determined by a simple probability calculation, and environmental factors.

The modeling program does away with a huge handicap to agronomical innovation: the time factor. "In arboriculture, for instance, experimentation requires such long time intervals that new techniques are discovered empirically, with the random occurrences that you can imagine," comment staff at the Gard Fruits and Vegetables Interindustry Technical Center. The Center is experimenting with the Montpellier program to improve the planting and management of apricot orchards. Foresters are also interested in using it, to try to perfect the management of saplings by varying the type of soil, climatic conditions, or the frequency of prunings. "Since the economic profitability of a forest is determined in the first 10 years of its life, Amap's economic fallout may be substantial," remarks Mr. Patrice Devos, director of the Forest Development Institute. Research to model hedges is also intensifying.

Another field of application is horticulture. In Aramon in the Gard region, the IPH Company, which produces greenhouse roses (1.5 million cut stems a year), is improving the flowering of its plants through computer imaging.

Twenty programs have been sold in France and abroad for 200,000 French francs [Fr] since January of 1991. They are being marketed by a Toulouse company, High Performance Technology, that distributes them for CIRAD. An agreement has been signed with the Japanese company Sumitomo. But the buyers have all been landscapers and local collectivities. No agronomic institute has yet shown an interest.

France: In Vitro Cloning Technique for Coconut Palm Under Development

92WS0078B Paris LE MONDE in French
16 Oct 91 p 14

[Article by Jacques Monin: "A Test-Tube Coconut Tree"; first paragraph is LE MONDE introduction]

[Text] A new cloning technique developed for the oil palm can now be used to reproduce coconut trees in the laboratory.

Five oddly massive test tubes lie in a culture room of the French Agronomic Research Institute for Cooperative Development (ORSTOM, or Bureau of Overseas Scientific and Technical Research) in Montpellier. Inside them, on a blackish solid medium composed of algae and charcoal extracts, five tiny coconut trees are unfolding their long linear leaves. These tubes, which are probably the largest in in vitro vegetable culture, contain clones that are barely a few months old and that were grown from the cells of twin coconut palms. The discovery is a significant one, for although the technique of in vitro reproduction has become common for many plants, from strawberries to banana and rubber trees, since the 1970s, the coconut palm had remained intractable until now.

A technique referred to as "microslip growth" is used to grow rubber trees in vitro. With it, researchers can select and nurse the growth in a sterile medium of a natural bud that will produce several stems, which in turn will generate other buds. Banana trees require a somewhat more sophisticated method. The inside of a single bud—the meristem, taken from the heart of the plant—is cultivated to produce several stems in the test tube, thereby improving the plant's initial potential.

In the case of the coconut palm, the mixed ORSTOM-CIRAD (International Center for Cooperation in Development-Oriented Agronomic Research) team in Montpellier took a leaf from another technique, now widely employed for the oil palm. It is called "somatic embryogenesis." Roughly, it consists of deriving from bits of leaves or flowers cut from the tree an embryo that is capable of developing a process comparable to the one that develops in the coconut.

Using the culture medium in the test tube, the cells that had been "programmed" for a specific function (leaves or flowers) will be "dedifferentiated." This produces a wedge, a tissue made up of actively dividing cells that retain their memory of all the plant's potentialities (the potential to produce stalks, roots, flowers, or an embryo), but that no longer have any precise role. All that remains to be done is "redifferentiate", or reprogram them. The tissue will then transform itself into a bipolar embryo that will grow roots and stems.

The transformation phase is triggered using subtle doses of minerals, sugars, vitamins, and above all vegetable hormones that are adjusted through "direct" microscopic monitoring of the embryo's development. Once it is formed, the embryo synthesizes its own endogenous hormones. It will then develop very slowly—in the dark during the first few months, then in the light—gradually becoming accustomed to an outdoor environment similar to that of the tropics.

The only fly in the ointment is the slowness of the process: It takes an average of two years for a culture to grow a plant. That, undoubtedly, is the real present limitation of the Montpellier discovery, which opens up immense prospects for the copra-oil-producing countries (the Philippines, Indonesia, South America). Indeed, the latter are cruelly in need of rejuvenating their production through high-yield coconut trees. The in vitro technique would make it possible to multiply the number of high-quality perfect twins, and the conclusive experiments that were conducted on the oil palms of the Ivory Coast raise hopes of a real future for the cultures.

It is too early to cry victory in the case of the coconut palm. Though ORSTOM has gained a lead, it currently has only five different clones, and it is not yet known whether or not they are strictly identical to their twins or even whether they are reproducible. That is the object of a new research phase whose outcome, given the slow growth of the plant, will not be ready for assessment for another five years.

Tropical Cultures

Created in 1970 under the name of GERDAT (Research Group for the Development of Tropical Agronomy), France's primary hub for tropical agronomical research was first reorganized in 1984 and renamed the Center for International Cooperation in Development-Oriented Agronomic Research (CIRAD).

It was placed under the joint authority of the ministers of research and technology and cooperation and development. At that time the technical and scientific establishment, which is unique in France, clearly redefined its mission: "To contribute to the rural development of hot-climate regions through research and experimentation, primarily in the agricultural, forestry, and agro-food sectors."

CIRAD has a staff in 1991 of 2,100 (over 1,000 of them engineer-researchers) and an annual budget of 900 million French francs [Fr] that is 63 percent funded by the state (out of the civilian research and development budget). It is now confronted with the same question facing all European tropical agronomic research organizations: How can more be produced on land that is henceforth limited without exhausting it?

Although the goals are pretty much the same on all the continents (intensifying productive systems, battling environmental degradation, improving products), the solutions will differ for each country, each province, and even each tropical locality depending on technical conditions and the socio-economic context.

The Research Ministry has asked that CIRAD be restructured. Its upcoming reorganization, says Mr. Henri Carsalade, its director, will be based on "the study of the main risks of disequilibrium in the long-term evolution of third-world agricultures. With that analysis as a starting point, we will have to reorganize some of our research centers, find new partnerships—with tropical-country institutions, but also with our French and European collaborators—and redefine our geographical strategy."

An initial concrete measure will be proposed to the board next December. It will entail the creation of three new research departments, responsible for work on perennial plants (palms, coconut trees, rubber trees), annual plants (cotton, peanuts, food crops), and agrarian systems and rural societies respectively. Of the 1,023 professional scientists currently assigned to CIRAD, 517 will work in France, 108 in the overseas departments and territories, 320 in Africa and the Indian Ocean, 38 in Latin America, and 40 in Asia and Oceania.

France Proposes Genetic Engineering Controls

92WS0062D Paris AFP SCIENCES in French 3 Oct 91 pp 46-47

[Article: "Toward a New Control Procedure for Genetically Altered Organisms"]

[Text] Paris—Everywhere in the fields of health, agro-food and pollution control, the increasing number of uses for

genetic engineering is gradually leading national and international bodies to adopt regulations to protect man and the environment from the consequences of creating genetically altered organisms and introducing them (intentionally or accidentally) into the environment.

That is why Messrs. Hubert Curien and Brice Lalonde, the ministers respectively for research and environmental affairs, moved to secure the concurrence of the Council of Ministers on 2 October for proposed legislation which would set up regulations pertaining to genetically altered organisms (OGM's) while leaving issuance of research, production and release authorizations in the hands of the Ministry of Research and Technology.

The bill implements two [European] Community directives adopted in 1990, one covering procedures in confined laboratory environments, the other covering release of OGM's to the environment. The bill, if passed by Parliament, would require advance authorization before any work on OGM's is performed at a certified confinement facility and before such organisms are introduced into the environment.

The bill puts more powers in the hands of the genetic engineering commission, which was already given the task of assessing the inherent risks in these operations. Another commission would also be created to evaluate the risks of releasing organisms to the environment.

Rightly or wrongly, ecologists in many countries have opposed genetic engineering on principle, since in their view it could alter plant and animal species and therefore the environment. This opposition has led to adoption of regulations that in some cases are so restrictive that firms specializing in biotechnology or bioengineering have opted to move to other countries—something which it is hoped will not happen in France.

The economic potential of these technologies is very real: They can lead to genetically engineered production of vaccines, selective insecticides, resistant plants, and products that could reduce pollution levels in soil and water, detoxify waste, or turn it into economically viable products.

The bill provides that violation of the regulations would be punishable by imprisonment or fine, as well as permanent shutdown of the installation responsible.

According to the government, the legislation "should subject genetic engineering to a regulatory regime that is both simple and useful, without yielding to the temptations of meddlesome control or a pseudo-democratic approach that would involve the participation, in discussions of the potential dangers of a genetic modification, of representatives of associations that would not even be able to understand the nature of such modification." Here is the portion of the Council of Ministers communique that deals with this matter:

"The minister for research and technology and the minister for environmental affairs presented a draft bill on control over utilization and release of genetically altered organisms, modifying the 19 July 1976 law on environmental confinement installations.

"The techniques of genetic engineering offer possible benefits in many domains such as health, agro-food production and pollution control. But it is necessary to control the use of organisms created by these techniques to prevent the effects on human health and the environment from their accidental or intentional release.

"The draft bill implements two Community directives adopted in 1990 to this end, one covering utilization in confined settings, the other covering intentional release of genetically altered organisms.

"1) The utilization, in a confined laboratory or factory setting, of organisms produced by genetic alteration will be subject to the law on environmental confinement installations.

"The state will issue specific instructions to each operator and will have the authority to veto certain operations without advance approval. It will also have the power to suspend operations or veto the carrying out of an operation previously authorized, in the event new scientific information surfaces. A genetic engineering commission will assess the risks posed by genetically altered organisms and the procedures utilized to produce them.

"2) Release of genetically altered organisms, whether for testing purposes or to put a product on the market, will be subject to prior authorization. When a product has already been authorized or certified in some other connection, a consolidated procedure will be employed, as is done with medications or phytosanitary products.

"The decisions, including such special instructions as may be necessary, will be taken after an opinion is rendered by a study commission on the release of products deriving from biomolecular engineering. In any case where a new risk evaluation justifies it, authorization may be suspended, tied to compliance with new instructions, or withdrawn."

Germany: Highly Selective Protein Separation Technique Developed at Bielefeld

92WS0141A Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 17 Oct 91 p 8

[Unattributed article: "Highly Selective Separation Technique for Proteins: Purification of Recombinant Proteins/Protein-Specific Metal Complexes"]

[Text] Frankfurt, 16 Oct—The fermentation technology research team of the University of Bielefeld's School of Engineering is currently developing an interesting process for separation of a specific protein from a mixture

with many different proteins and other macromolecular materials. The process would reportedly be of interest especially for the purification of recombinant proteins in biotech production.

The process is based on the observation that specific amino acid residues of proteins, primarily histidine, interact with and form complexes with various metal ions such as zinc, copper, iron, and nickel. Consequently, Erwin Flaschel and his colleagues from Bielefeld provide tiny beads of porous polymeric plastic or glass with chelate ligands which bind a transition metal ion.

If such plastic balls are mixed in the extract of a bacterial culture, proteins with appropriate side groups bond onto the ion-charged carrier and can be readily separated along with the beads from the remaining cell liquor. Then, the protein is detached from its carrier by means of a change in the salt content or the pH value.

The method is inexpensive, simple, and versatile. However, to date, it still has the disadvantage that many different single-celled proteins have such side groups which interact with the ion-charged plastic beads. Consequently, the separation process is still not very specific.

However, the Bielefeld researchers are attempting with genetic engineering tricks to shape the protein to be isolated in such a way that it bonds preferentially with the ion partners offered. But, the ion-friendly group incorporated into the molecule must be readily split off after isolation, making it possible to obtain a product which has only the planned protein structure.

The researchers are therefore incorporating a recognition sequence for a proteolytic enzyme into the region for the ion bond so that it is possible to remove the other amino acids cleanly after the separation process. In cooperation with a Swiss company, the Bielefeld researchers are currently developing new carrier substances charged with chelate ligands. Also, they are working on protein-specific metal complexes to obtain the cleanest possible separation of only one specific protein in each case.

New Cell Separation Techniques for Pharmaceutical Production

92WS0072B Duesseldorf VDI NACHRICHTEN
in German 11 Oct 91 p 22

[Article by Wolfgang Asche: "High-Tech for the Biofactory: Increasing Frequency of Continuous Operation in Fermentation and Product Recovery"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 11 Oct (VDI-N)—Biotechnica 91: Production of complex molecules requires costly culture process.

Complex engineered active ingredients for new pharmaceuticals can no longer be produced in easy to grow

bacterial cells. Here, animal cells are serving as a biological "factory," a situation which opens new areas for the use of high technology.

Biotech processes have developed from the empirical craftsmanship, such as the brewing of beer, into a highly technical, science-based interaction of biochemistry, microbiology, and engineering. The level and directions of development of today's biotech processes and products are reflected in the upcoming Biotechnica trade fair.

Representatives of the pharmaceutical manufacturer Thomae are travelling from Biberbach to Hanover with a large spectrum of offerings. The firm, which belongs to the Boehringer Ingelheim Group, intends to give a glimpse into the production of tissue plasminogen activator (t-PA), a bloodclot dissolving agent against heart attacks, in genetically altered hamster cells. Thomae itself has combined equipment such as fermenters, valves, sterilizers, and control technology; most are products of Switzerland, Sweden, and the United States. "The German instrument industry has pretty much been asleep as far as biotechnology is concerned," according to company spokesman Arnold Kastenholz.

The major problem in the use of animal cells is their sensitivity to mechanical forces which occur during intensive mixing in the fermenter. Remedies are provided by special stirring instruments or by fixation of the cells in the pores of carrier materials which offer the cells a supporting framework such as they had in the organism from which they came.

Compared to animal cell cultures, fermentations with the bacterium *Escherichia (E.) coli* are simpler to perform in terms of the danger of mechanical injury; however, they present new process technology problems, since they must be destroyed before the product enriched in their interior can be recovered.

Biotechnologist Roland Wagner of the Society for Biotechnical Research (GBF) in Braunschweig mentions additional differences: "Animal cell cultures grow much slower than single-cell cultures. It takes 16 to 72 hours, i.e., days, to obtain cell doubling. Harvesting is possible only after six to eight weeks of cultivation time."

Continuous operation during which the product is continuously removed can bridge large pauses in production. There are already processes in which cells pumped in a circuit are separated from the protein solution by filters, however, according to Wagner, "Because of gradual clogging of the filter membrane, long-term continuous operation is not possible." Consequently, the GBF, along with the company Westfalia Separator in Oelde, recently began development of a membrane-less system for separation and recovery of the cells in the reactor. However, according to him, fixation on carriers and continuous production in fluidized bed fermenters has not yet caught on in the industry.

There is great market potential in cell cultures because cell cultures are usually essential for complex engineered

active ingredients such as t-PA, erythropoietin (EPO), or interferon since it is only in them that the complete protein structure including nonprotein side chains can be produced.

Ulrich Meier of Westfalia Separator describes the cell separator developed along with the GBF, which is being introduced at Biotechnica: "The culture liquor is continuously removed from the fermenter and the cell mass centrifuged out." Mechanical stressing of the cells by gravitational forces is avoided by a relatively low rotation speed of the centrifuge.

The operation of the fermenter/separator coupling has already been successfully tested with the GBF with so-called hybridoma cells, which produce monoclonal antibodies for medical diagnostics. According to Meier, there is a trend toward continuous production and away from "batch operation."

Cell culture is only half the work. Approximately 50 percent of the overhead in biotech processes consists of downstream processing, which means the processing of the culture liquor from the fermenter and the purification and isolation of the product. In addition to the established processes such as chromatography, centrifuging, and filtration, the Fraunhofer Institute for Interfacial and Bioprocess Technology (IGB) in Stuttgart wants to establish a new separation process. "At Biotechnica, we are looking for customers for our electrodialysis with bipolar membranes," says IGB's Bernd Bauer. Electrodialysis isolates charged particles from aqueous solution without thermal or chemical stress through the interaction of an electrical field and ion exchanger membranes. It is reportedly ideal for fermentation products such as citric acid or acetic acid, and also for amino acids.

Will the expectations of the exhibitors for new markets for biotech developments be met? Thomae spokesman Kastenholz is optimistic: "Through the genetics law we now have legal security." However, Dr. Dieter Brauer, biotechnology expert at Hoechst in Frankfurt am Main, is pessimistic. "The mood is generally bad." He sees problems for small and medium-sized companies. "Small and medium-sized companies can hardly continue to compete because the time required for approval of biotechnical production systems is too long in Germany."

Use of CAMD in Mass Production of Pharmaceuticals Discussed

92WS0071A Duesseldorf VDI NACHRICHTEN
in German 11 Oct 91 p 18

[Article by Burkhard Junghans: "Medications Like Magnetic Arrows: Architects of Pharmaceutical Research at the Computer"]

[Text] Frankfurt, 11 Oct 91—High-speed computers and high-resolution graphics screens are gaining admission

into pharmaceutical research laboratories: "Computer-Aided Molecular Design" (CAMD) is opening promising vistas in the development of "tailor-made" medications with low side-effects. The active ingredients are structurally varied until the optimal "fit" for the appropriate receptor is found. Lower developmental costs for the chemical compounds and fewer animal experiments are only some of the advantages.

Medications which work like magic arrows, striking the seat of a disease exclusively and precisely, have been a dream of scientists since the pioneering days of pharmaceutical research. But so far only partial victories have been recorded in realizing this ideal goal. We still know too little about the causes of many illnesses, particularly about what is taking place at the molecular level. The structures of many active ingredients are too complex, especially when we are dealing with three-dimensional protein compounds, such as hormones or the innumerable antibodies of the human immune system. The transport phenomena and the reciprocal relations of these active ingredients with the no less complex membranes and receptors of the cells of our organism are also too complicated.

Molecular biology and biochemistry have played a decisive role in explaining many of these phenomena. Biotechnology and gene technology make it possible to purposefully alter a whole range of endogenous substances and to produce them in sufficient quantities that they can be processed into medications or at least are ready at hand for basic research.

"On this basis computer-aided molecular design can help in future to take us one step further on the path towards tailor-made medications," explains university lecturer Dr. Wolfgang Schubert, who is the director of the CAMD division of the pharmaceutical firm of Hoechst in Frankfurt. But he said that a series of special problems would have to be overcome to make it possible to use CAMD intelligently and economically in the development of medications. In working with pharmacologically interesting active molecules on the computer it is not enough to know their chemical composition. The three-dimensional structure must also be known; biomacromolecules generally consist of several thousand atoms. In order for us to make statements about the "architecture" of such molecules, the substance must be available in sufficient quantity in highly pure crystalline form. Only then can the three-dimensional structure be revealed either by X-ray analysis of structure, which is very costly in time and money, or with the help of nuclear magnetic resonance spectroscopy (NMR). So far the structure is known for only a few hundred proteins, and only a few dozen of them figure as potentially interesting receptors for active ingredients in medications.

A further requirement is sufficiently fast computers. For CAMD a very large number of complex processes must be calculated, such as the relative position of molecules and their mutual spatial and electrostatic effects. The large amounts of data which accumulate in the process

can only be evaluated if they are graphically represented on the screen by suitable programs.

If all the requisite properties are to be rigorously calculated, the fastest computer now available requires about one hour to describe a macromolecule of a few thousand atoms. Even then, the result is only a snapshot. But for most medically interesting molecules and their interactions with the receptors, this time span must be increased at least up to one-thousandth of a second. This would theoretically give a calculation time of approximately 100,000 years.

Once the effects of a material on the molecular level are understood, two central questions of "drug design" can also be answered. First, why do two very similar representatives of a class of substances reveal very different effects on the organism or the course of an illness? Second, how is it possible that two completely different active ingredients bring about very similar effects?

Researchers are faced with almost insuperable barriers, for often it is only the symptoms which can be alleviated, while the causes of many diseases cannot be treated. This is true not only for many major diseases of the general population, such as cardiac and circulatory illnesses and allergies, but also for AIDS and other immune deficiencies or infective diseases like malaria.

That is why great hopes are being pinned on new medications based on endogenous activators in the human body. For example, they are involved in the interplay of the highly molecular protein compounds, of which there are estimated to be about 100,000 different kinds in the human body. Proteins not only provide the lion's share of our body's makeup, but also play a decisive role in almost all developmental and metabolic processes, e.g. in the form of hormones, the message-bearing and signaling materials of life, or in the form of enzymes, without whose catalytic effect hardly any metabolic processes would function. The same is true for the antibodies of the immune system, which protect us from infectious diseases and poison.

For the interplay in this closely-woven structure of proteins and other endogenous activators, such as nucleic acids, sugars or peptide hormones, to function without friction, the participating partners in a reaction must recognize one another, link themselves together and react with each other. In this process the three-dimensional structure is decisive, e.g. the "folding" of the polypeptide chain of a protein which determines its biological activity. This is ensured by the characteristic surface structure of the proteins, frequently in the form of fissure-like indentations. These linkage points or receptors and the corresponding structures of the reactive partner fit together like a lock and key. Mix-ups and failures in this lock-and-key system are usually the deeper causes of illnesses. Many medications are imitations of such endogenous "keys." They can replace a

missing ingredient, such as insulin, by acting as a substitute "key," or they can block the production of a harmful substance (e.g. an excess of cholesterol). The better the "key" of the medicinal ingredient fits the "lock," i.e. the receptor, the more effective the medication is and the more specific the therapy can be, thus in turn reducing undesirable side effects.

This is precisely where the pharmaceutical researchers apply CAMD. They know the "lock" through the structure of the receptor, and they try to construct the best fit in a "key," the activator for this "lock." All calculations serve to establish how well the "key" fits, i.e. how well a designed substance works. However, in most cases it is not the structure of the receptor, the "lock," which is known, but only a series of more or less effective compounds. In this case these indicative substances are compared with each other, and all the properties which enhance the effect are identified.

On the screen all the molecules' essential properties can be simulated and repeatedly varied until a variant substance is found which exactly complements the "active center" of the receptor, which guarantees the effective and precise linkage between the two—a puzzle which can take many months to solve because of the size of the calculations involved.

"The result of our theoretical work is an exact structural suggestion to the chemists for the synthesis of this substance or for obtaining it by gene technology," Dr. Schubert explains. He adds that a constraint on CAMD lies in the fact that so far only a few receptors are well enough known to be worked with.

Using the classical non-specific screening of active ingredients on the "trial and error" principle, up to 10,000 substances have to be tested to obtain one that is usable. Up to the 60's and 70's, the development of new compounds was usually on the principle "from the substance to the therapy." But now the strategy—"From the therapeutic goal to the substances"—is becoming a more and more indispensable tool. Medically interesting substances can already be evaluated in the planning phase and isolated if necessary. Thus the path to an effective and also well-tolerated medication is significantly shortened. But this also means that fewer of the animal experiments required by law for all pharmaceutical testing are necessary. Finally, CAMD provides valuable insights into the causes of diseases on the molecular level.

At Hoechst, for example, substances have been developed with CAMD which may possibly be useful in the treatment of AIDS or certain lung diseases. The greatest strides have been made with a substance which blocks the synthesis of cholesterol and is thus suitable for the treatment of arteriosclerosis and coronary disease. Dr. Schubert sums it up this way: "Even if we can't expect any dramatic breakthroughs from CAMD in the short term, it is becoming clearer and clearer that in the future

active ingredients will be less and less an object of search, and more and more specifically designed."

New Waste Disposal Technologies Aired at Biotechnica 91

92WS0106A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Oct 91 p 8

[Article by Scha.: "Processes to be Used in Medicine, Agriculture, and Nutrition"]

development, and the industrial use of biotechnology and biotechnological solutions are the predominant topics of this year's Biotechnica in Hanover (22-24 October), which, over the past seven years of its existence, has developed into one of the biggest special fairs in this field. Concentration on central areas of application, in addition to the topics of health/medicine, agriculture, and nutrition, lends special significance to the entire environmental sector in view of the noxious substance problems existing all over the world.

The annual number of more than 2,000 incidents involving water-threatening substances in the Federal Republic of Germany alone, and the estimated 70,000 suspected surfaces containing toxic waste in the old federal states alone, will document the enormous action required for rapid and effective noxious substance decomposition. Here, the methods of biotechnology are increasingly assuming significance in competition with the conventional-physical processes. According to data supplied by the Federal Environmental Bureau, fuel oil is involved in around 75 percent of the incidents leading to soil contamination. Particularly, it is in connection with these mineral oil contamination cases that microbiological purification processes proved their value on a large industrial scale in past years. The foundation of all of the biological processes offered is the ability of certain bacteria and fungi to use hydrocarbon compounds as nutrients and to convert them into carbon dioxide, water, and inorganic salts or intermediate products that can be further broken down. At the end of a biological sanitization process, we are left with a highly purified, viable soil that can again be used in many different ways—this being one of the big advantages compared to the conventional dumping as special refuse or burning.

Essentially, there are three different concepts that proved themselves in each case for the corresponding area of employment of the actual biological sanitization process. "On-site" means that, in case of contaminations near the surface, the soil is enriched directly at the place of the damage with microorganisms and additives. Possibly, there will be a mechanical loosening of the soil for better oxygen supply or hydraulic measures with subsequent water purification in a bioreactor.

In the "on-site" process, the soil is extracted and is further processed on the spot in special plants, for example, in mobile bioreactors or biobeds. For this purpose, the contaminated soil must be homogenized

and enriched with structure-improving substrates, such as, for example, straw. In biobeds, the earth is regularly irrigated and is used for oxygen supply.

Numerous offerors are already operating regional waste disposal centers ("off-site"), in which biobeds, in expensive systems, are coupled with biological waste water and waste air purification. The contaminated soil of course must for this purpose first be transported rather expensively over longer distances; but the better technical equipment of the centers frequently facilitates a cost-reducing acceleration of decontamination. The bio-purified soils can continue to be used further as soon as the residual loads prescribed by the supervisory authorities have been attained.

Agriculture also hopes to derive a whole series of advantages from biotechnology, such as, a specifically goal-oriented, faster improvement of the product quality by means of new possibilities of plant and animal breeding, reduced environmental stresses from biological plant protection, and expanded sales possibilities for reproducing raw materials and industrial crops. From science, we get biological methods of plant breeding, such as cell fusion, gene transfer, and cell or tissue culture techniques, to cut breeding times in half.

Today, the chemical industry in the Federal Republic covers 10 percent of its raw material requirements from reproducing raw materials. Thus, the chemical industry is interested in ricinus and eruca-acid-rich rapeseed, as well as sunflowers, while the textile and paper industry is looking into traditional fiber plants, such as flax and hemp but also for chemical plants, not yet found in Europe, such as kenaf, miscanthus, and fiber sorghum. Bitter lupine also has great opportunities for disadvantaged areas in the Mediterranean basin.

The use of vegetable constituents in industry is concentrated on production lines for sugar, starch, vegetable oils and fats, wood and cellulose, plant fibers, as well as medicinal and spice plants. The energy-wise use of biomass involves bioethanol as engine fuel, vegetable oils as fuel and lubricants. Procurement of heat from the biomass also plays a role.

Molecular biology and cell biology led to a basic expansion of the insight into pathological mechanisms in the health sector likewise so that it was possible to develop a new field called "molecular biomedicine." Gene technology processes offer a possibility of recognizing pathogenic states early, especially through the use of nucleic acid analysis.

Major central development points are discussed at a scientific congress. Numerous general events take up topics such as bio-data processing, bio-patents, bio-financing, and bio-job, with the visualization of career fields and the brokerage function between specific job demand and supply. Data banks offer access to resources in terms of know-how in biotechnology and related areas.

BLICK DURCH DIE WIRTSCHAFT, 23 October 1991

German Industry Said to Face Overestimated Market, Waning Official Commitment

92WS0072A Duesseldorf VDI NACHRICHTEN
in German 11 Oct 91 p 21

[Article by Peter Frey and Christa Friedl: "Disappointed Hopes in the Biomarket: Market Potentials for Genetically Engineered Drugs Were Frequently Overestimated"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 11 Oct (VDI-N)—Biotechnica 91: Increased knowledge in research does not always lead to products.

An industry sends out invitations: 450 exhibitors from 20 countries present biotechnology innovations in Hanover from 22 through 24 October. However, high sales figures cannot disguise the fact that the market for genetically engineered products was overestimated. Contrary to all advance reports, the German genetics law has not yet worked as a catalyst.

Microorganisms produce beer, wine, and yogurt, substances against anemia or diabetes; they can clean up oil-contaminated soil and break down complex organic toxins. Business in the "living factory" is booming, but no one knows exactly how large the market currently is. According to reports last year at Biotechnica, sales of about 40 billion German marks [DM] are achieved annually worldwide with biotech products and processes. The EC Commission estimates the market at "merely" DM15 billion.

Conventional biotechnology, i.e., the processes with naturally occurring organisms, no longer offer much room for revolutionary developments. Here, the trend is toward increasingly perfectly controllable culture techniques and continually higher product yields through improved processing. Additionally, routine tasks in the lab—in which great errors can occur through extremely small inaccuracies—are increasingly automated and thus more certain.

In contrast, work with genetically manipulated organisms offers room for radical innovations. To date, this publicly debated branch of biotechnology enjoys a share of only a few percent of overall production. "Only in the pharmaceutical industry," assesses Prof. Leopold Flohæ, Scientific Director of the Society for Biotechnical Research (GBF) in Braunschweig, "approximately 10 percent of the processes work with genetically manipulated organisms."

In genetic engineering—foreign genes which carry the code for production of a protein are incorporated into a specific organism—usually a bacteria cell. The cell thus manipulated then produces the desired substance in large reactors with an appropriate nutrient solution (fermentation).

This small offshoot of biotechnology holds great potential. Genetically altered bacteria and cell cultures can provide custom pharmaceuticals or plant substances on an industrial scale, which can be obtained in only minimal quantities through conventional chemical processes. However, in biotechnology a wish is not the same as reality. "One must never forget that the market for such specific pharmaceuticals is very limited," stresses Flohae. The former research director of the Aachen company Gruenenthal cites one example. With the development of the so-called tissue plasminogen activator (t-PA), which can dissolve blood clots in heart attack patients quickly and without surgical intervention, the Aachen company expected a few years ago to corner a million DM market. "To date, at least in Germany, t-PA has very limited use," admits Flohae. The number of heart attack patients is small—the drug expensive.

There are also disappointments for the time being in the area of environmental protection. It is true that microorganisms can break down chemically complex substances in soil or water—but not completely and also not within a short time. The use of genetically engineered activated organisms could bring progress here, but first, according to Flohae, "The discussion about the release of such organisms must be dealt with objectively."

Another of the central areas of application is currently molecular biomedicine. With increasingly perfected methods, biologists and physicians are tracking the mechanisms of transmission of genetic data or of regulation of cell growth to better understand the causes of illnesses. This is where the experts see tomorrow's real market. It will be analysis rather than genetically engineered production which will create the much evoked billion DM market. Molecular tools such as antibody diagnostics or the polymerase chain reaction (PCR) developed in 1985, with which extremely small quantities of pathogenic materials can be detected, are on the verge of revolutionizing medical diagnostics.

In the GDR as well, long before the change, those in charge recognized the research potential and market opportunities of this branch of industry. "In the GDR biotechnology was a prestigious project," recalls biotechnologist Prof. Harald Voss about his own scientific work in Leuna and Halle. With a group booth shared by 17 exhibitors, the eastern German states are making their debut at Biotechnica. Their primary objectives are to enhance existing business contacts, prepare for new cooperation, and to stabilize fledgling companies.

The BMFT [Federal Ministry for Research and Technology] has reacted to the special situation of the eastern German companies with simplified procedures for development of grant applications within the framework of the "Project for Funding of Biotechnology in Small and Medium-Sized Companies." If the European Community approves, Bonn will support the development of new products and processes with DM20 million annually. "Much too little," judges Flohae. The GBF director

views the stagnation in public funding with concern. Dr. Ekkehard Warmuth of the BMFT's Biological Research and Technology Section agrees: "We are very unhappy that public funding has not increased."

Even the EC is opening its aid coffers for biotechnology only hesitatingly. Between 1990 and 1994 it intends to encourage pure research projects with a total of DM700 million in the member states. According to one report, the aid is to be "gradually expanded," but oriented more than before "to the future needs of the economy."

Nordic Joint Efforts on Yeast Cell Research

92WS0121A Stockholm NY TEKNIK in Swedish
24 Oct 91 p 26

[Article by Birgit Andersson: "Joint Nordic Yeast Research"—first two paragraphs are NY TEKNIK introduction]

[Text] Nordic biotechnicians will now get together on joint yeast research.

"Yeast cells resemble human cells and will therefore be an important tool in future hybrid DNA technology," said Kerstin Straby, associate professor at Umea and leader of the Scandinavian cooperation.

Today the E. coli bacteria is the most common microorganism in the laboratories of hybrid DNA technicians.

The bacteria functions as a so-called production organism and is made to produce the substances biotechnicians want to utilize.

"But yeast cells are much safer for human beings. In contrast to bacteria, yeast cells are of the same type as human cells and are therefore more natural to work with," explained Kerstin Straby of the Microbiology Institute at Umea University.

With contributions from the Nordic Industrial Fund, Pripps and Jastbolaget, among others, and at the request of the Biotechnical Research Foundation in Sweden, she has administered education, international trips for doctoral candidates and Nordic projects for the last four years.

Her work has now also resulted in a joint yeast research network covering Iceland, Norway, Sweden, Finland and Denmark.

Easy to Grow

The E. coli bacteria is easy to utilize in hybrid DNA technology. It is well-known to researchers and it is easy to grow.

Produces Fever

But there are problems with the bacteria.

The *E. coli* bacteria's cell wall contains a component that produces fever in human beings. And although purification procedures in drug manufacturing, for example, are extremely thorough today, contamination can slip through.

For this reason Denmark's Novo Nordisk now makes its hybrid DNA-produced insulin with yeast cells.

And there has long been extensive yeast cell research at the Carlsberg breweries.

"Intensive yeast research is now going on around the world," said Straby, "but many problems remain to be solved."

One of the problems is to get yeast cells to secrete the substances they are supposed to produce.

Another problem with yeast cells is that the newly-formed proteins can be supplied with extra sugar groups.

This means they cannot be used in drugs, among other things.

Exchange Experiences

Nordic yeast researchers will now meet at regular intervals to exchange experiences. The first meeting was held in Denmark in September of this year. Representatives from 22 industries got together and discussed yeast. The next meeting is planned for Finland, which conducts extensive yeast research at the Technical College outside Helsinki.

Swiss Report on Genetically Modified Potatoes

92MI0167 Bonn DIE WELT in German 5 Dec 91 p 23

[Text] Swiss field trials with potatoes inoculated by genetic engineering, at Changins on Lake Geneva, have been successful, say the scientists involved. The plants immunized against parasite viruses yielded good harvests, stated Alexandre Vez, director of the Swiss Agricultural Research Institute at Changins, yesterday. He reported that the potatoes had been 100 percent protected against virus infection, though the variety used for this experiment, "Bintje," had altered their shape, becoming elongated. The causes of this alteration are expected to be revealed in a second experiment next year. Tests are also needed to show whether the immunized potatoes still taste the same as the originals. This was the first field trial with genetically manipulated plants in Switzerland. According to Alexandre Vez, genetic immunization can also be used with other varieties of potatoes and plants, such as grapevines, fruit trees, berries, and turnips. Swiss environmental organizations criticize the research institute for not having investigated whether new viruses were created in the experiment: Greenpeace considers that field trials are uncontrollable, and that genetic engineering repeatedly shows how little researchers actually know about biological correlations.

France: Mimetics to Continue Neural Network Applications Development

92WS0085C Paris INDUSTRIES ET TECHNIQUES
in French 6 Oct 91 p 17

[Article by Thierry Mahe: "Character Recognition: New Frontier for Neural Networks"]

[Text] Mimetics, the start-up company whose strong point is neural networks, is now turning its attention to automatic text reading via optical character recognition (OCR). Serge Dahan, formerly with Olivetti, Bernard Angeniol, ex-research director at Thomson-SGS, and Francoise Faugelman, a highly regarded theoretician of the discipline, are the driving forces behind this company, which was founded a year ago. Obviously, it has a wealth of expertise in this brand-new computer technology based on mathematical modeling of the human brain. All the same, it needed an engine of growth. And that is what it obtained last July with its takeover of Inovatic.

Inovatic, the once-rising star of the OCR field, has joined the long line of French high-technology PME's [small- and medium-sized enterprises] whose efforts have been rewarded with praise...and little else. The dynamic growth forecasts for the OCR market failed to pan out, and Inovatic's annual sales stagnated at a pitiful 10 million French francs [Fr]. However, it was not a bad buy: In acquiring Inovatic, Mimetics obtained a line of high-performance products, some prestigious references in industry and banking, a little network of distributors in Europe, and a beachhead on the American market.

Bernard Angeniol's objective: "To become the European leader in automatic reading. With neural networks, we are going to improve the already excellent performance of Inovatic's software. Starting in 1992, and on the Macintosh." OCR technologies are expected to show strong growth in banking and in the document services of large enterprises.

In addition to that product, the gamut of services offered by Mimetic extends from artificial vision to quality control, industrial process management and even the military sector. That makes it both France's only "serious" purveyor of neural networks and the only manufacturer specializing in neural network-based automatic reading. "HNC-Nielsen, in the United States, is the only other firm that offers both products and services," says Bernard Angeniol. Nestor, the American pioneer in the field of neuromimetic software, is now established in France, by virtue of a quasi-exclusive partnership with Dassault Electronique. And neither AT&T nor Intel, which design customized circuits, are really service providers.

Italy: SGS-Thomson Launches Fuzzy Logic Program*92MI0157 Milan AUTOMAZIONE E STRUMENTAZIONE in Italian Nov 91 p 132*

[Text] SGS-Thomson Microelectronics has launched a five-year plan to develop fuzzy logic components that will lead to a more flexible use of the systems that contain them.

The investment is expected to total approximately 40 billion lire. The plan will focus on embedded microcontrollers. SGS-Thomson Microelectronics are convinced that in the future control systems will be increasingly dominated by fuzzy logic which is more suitable than traditional systems in upgrading (in terms of speed, temperature, and other conditions) numerous industrial systems and consumer products.

The Agrate-based company estimates that the prospective market for fuzzy semiconductors will be worth approximately \$1 billion in 1995, primarily for embedded processors and microcontrollers, the very products that SGS-Thomson plans to develop.

Japan currently leads in the development of fuzzy logic hardware and software, and has achieved satisfactory results in the consumer area. However, work is under way to expand the use of this technology to industrial systems. An agreement has recently been reached by NEC and Omron Microelectronics on fuzzy microcontrollers, which are primarily designed for use in industrial automation systems.

The use of this kind of microcontroller in cars is under study at Motorola, while, the possible applications of fuzzy logic are being investigated by all major European automobile companies, Fiat included, which is examining the possible application in engines to improve performance.

SGS-Thomson, whose shareholders are two groups that are very receptive to industrial innovation, believes that the first products and first practical results of this research will be available as early as next year. Two approaches have been adopted. A dedicated coprocessor will be developed for sophisticated applications such as expert systems managed by workstations, while for industrial and consumer applications (such as washing machines and air conditioning systems), the company aims at developing two types of embedded processors a fully digital device based on fuzzy logic software, and a hybrid chip with dedicated fuzzy hardware.

DEFENSE R&D**France: Helios Program's Proposed All-Weather Reconnaissance Satellite Discussed***92WS0112D Paris LE FIGARO in French 5 Nov 91 p 12*

[Article by Jean-Paul Croize: "The All-Weather View of France's Future Spies"—first paragraph is LE FIGARO introduction]

[Text] Following an earlier decision to acquire two optical military observation satellites, defense [ministry] officials are now thinking about moving forward on radar technology...

Between 2001 and 2003, France might launch a spy super-satellite dubbed "Osiris," which, thanks to an advanced radar sensor, will be able to see everything on the planet's surface, even through the thickest clouds and on the darkest nights. This information was confirmed (in OBJECTIF DEFENSE, a monthly newsletter for military officers) by General Christian Fontaine, chief of the planning-programs-space division of the combined general staff. So it is clear now that France has decided to make an enormous effort to equip itself with spy satellites. To hear the strategists talk, within the next 10 years our country should catch up to the two superpowers in this domain, which the Gulf war demonstrated is truly indispensable.

Spy satellites have long been dreamed of, but they seemed to be the stuff of science fiction or futuristic espionage novels, as the USSR and the United States were extremely secretive about the way they were used. Then, in the war against Iraq, it became clear that these platforms had enabled the Western powers to prepare their strategy in perfect and exhaustive detail, exploiting the satellite data in an absolutely astounding way. All at once, the Ministry of Defense decided to strengthen dramatically the Helios spy satellite program, which had been entrusted to Matra back in 1987. Despite the recession, the portion of the Defense budget devoted to space next year will reach 3 billion French francs [Fr], a 17 percent increase in one year.

Fine Detail

Gen. Fontaine's statements confirm that the Helios program as it stands is only the first, purely "optical" stage of our space espionage program. In the framework of a Fr7 billion program, it has been decided to have Ariane launch two devices adapted from the Spot civilian observation satellites, whose powerful resolution (able to identify objects as small as 7 or 8 meters on the ground) was apparently exploited widely in the Gulf conflict. The two Helios will have a much improved camera made by Aerospatiale. The exact specifications are officially top secret, but the two will be able to distinguish details smaller than a meter from their orbital altitude of 6-700 km.

Currently, plans are to launch the first Helios in 1994 and the second in 1997. But the pace may be stepped up, in order to have two satellites in service simultaneously as soon as possible—by 1995, the military hopes. That would make it possible to overfly every point on the planet's surface at least once every 24 hours, providing real-time space intelligence—of how a conflict is progressing, for example—not delayed imagery that cannot be exploited to alter the course of the war.

But even with this capability, France will be far behind the Soviets—and especially the Americans—in space

observation. Thanks to their famous KH 11, which reportedly has a lens comparable to the 2.4-meter diameter lens of the space telescope, the Americans can make out details on the order of 10 cm at ground level. That resolution is fine enough not only to tell the make of a car but to read the emblem telling whether it is a diesel or GTI...

Cat's Eyes

Now that is really the stuff of dreams! But espionage technology has already advanced to even more astonishing capabilities. Among the technologies which the United States has mastered—and which France now officially admits it is interested in developing—are infrared and, above all, radar espionage. Both have a decisive advantage: They are free of the limitations of purely optical observation—which is impossible at night or when the target is under cloud cover.

According to well-informed sources, Matra is already working on specifications for several infrared super-Helios that could be launched by 1997-1998. They would still be blinded by clouds, which capture a significant percentage of heat radiation, but with their cat's eyes these satellites would see lots of interesting things, both day and night: In the daytime, for example, they could see the heat generated by the motors of tanks, even when the latter are camouflaged under branches amidst the densest vegetation.

The heat of their motors could be spotted just as infallibly at night. Computer programs should even be able to identify the specific type vehicle responsible for the "thermal signatures" spotted by these satellites, and with no risk of error: An armor column, even when moving with all lights extinguished, would be as visible at night as in broad daylight. The sensors to be developed—basically adaptations of those on meteorological satellites such as the European Meteosats—will be sensitive enough to detect the recent take-off of an air patrol from the "hot spot" left behind by the airplanes on the runway. It will also be possible to discriminate between an interceptor and a heavy transport aircraft.

After this intermediate stage, the final step to enable France to see everything from space would be taken early in the next century, with radar satellites. As some U.S. military brass indicated during the Gulf war, such devices are able not only to pierce the heaviest cloud cover but also to see underwater—where they can detect submarines on patrol to a depth of 100 meters—and penetrate rock. With the help of space-based radar, the Americans reportedly were able to spot some of Saddam Husayn's underground bunkers beneath several meters of sand.

In yet another project involving Matra (in collaboration with the British, through a joint subsidiary), French engineers have played an important part in the development of ERS 1, the European Radar Satellite developed for civilian purposes. But its sensors—relatively primitive compared to those used on American spy satellites—

cannot resolve details smaller than about twenty meters. Enormous technological strides will be required to discriminate details on the order of a meter, which U.S. satellites seem able to do. According to the French engineers, it will probably take a total investment on the order of Fr20 billion to develop the satellites themselves and the huge data processing centers on the ground that will be needed. Indeed, it is likely to be so expensive that such satellites can only be developed within the framework of a European defense system.

Matra to Revise Helios Program, Proposes All-Weather Radar Detection Satellite

92WS0102A Paris LE MONDE in French
31 Oct 91 p 11

[Article by Jacques Isnard: "Military Keeps Osiris Radar Observation Satellite Project"]

[Text] The multiyear military space plan (PPSM) prepared by the French armed forces general staff calls for the orbiting of an observation satellite, Osiris, whose radar capability will enable it to carry out missions day or night regardless of weather conditions. The satellite would go into orbit between 2001 and 2003.

Air Commodore Christian Fontaine, chief of the "space plans and programs" division on the general staff, made this disclosure in the OBJECTIF DEFENSE newsletter sent out each month to unit commanders in the three armed services. First produced in 1983 and updated every other year, the PPSM—for which Gen. Fontaine is responsible, under the authority of the armed forces deputy chief of staff—is used to help identify the military's medium and long-term space needs.

France has already started one program—Helios—to establish a military space observation system; other participants in the program include Italy (to the tune of 14.1 percent) and Spain (7 percent). By 1994 the program hopes to loft into orbit (at 400-800 km altitude) a satellite which is similar to the civilian Spot earth observation satellite but carries a more advanced camera transmitting digital images.

Besides putting one of the 2.5-ton satellites into orbit, the project involves the building of a second to be held in reserve in case the first malfunctions. Ground stations in France (at Creil, in the Paris region), Italy and Spain will process the data received. Total cost is estimated at some 6.7 billion French francs [Fr] (in 1990 money).

In its current form, Helios with its four-year life expectancy has several limitations: Its optical equipment cannot see through cloud cover, but more importantly it passes over the same spot only once every two days (once every 24 hours at low altitude). These limitations were accepted at the start of the program, when France's purpose was to acquire a so-called strategic intelligence satellite whose mission was to identify targets for a possible nuclear strike.

Today, with Defense Minister Pierre Joxe's emphasis on space-based strategic and tactical intelligence, the needs are different. Now what is important is to get more up-to-date information, more quickly, and with even greater precision, especially for so-called "crisis management" purposes, i.e. detection of troop movements or early signs of an impending attack, and monitoring compliance with disarmament agreements.

The Matra group, which is responsible for 60 percent of the Helios program under the overall project direction of the National Center for Space Studies (CNES), has proposed modifying the system to take into account the new needs identified by the military.

Budget Increase

Under this option, the first Helios would be orbited as planned in 1994, but the back-up satellite would not be held in reserve. Instead, it would be orbited the following year. Observations of the same terrain could then be conducted every 24 hours (every 12 hours at low altitude). A third Helios, to be orbited in 1998, would carry an infrared detector (for nighttime coverage, as well as detection of nuclear tests and missiles in powered flight) and anti-interference equipment (to pierce camouflage and chaff). In conjunction with the third Helios, there are plans to construct lighter, mobile ground receiving stations to serve military commands deployed overseas.

Most recently, Matra has carved out yet another niche for itself in Gen. Fontaine's PPSM with its Osiris program to build a radar detection satellite that could be operational early in the 21st century, perform continuous all-weather observation, and see through cloud cover. Because of its cost, this radar observation system will probably be designed in cooperation with other European partners. For some time now, Germany has made no secret of its interest in the project.

In addition to Helios and Osiris, France is committed to another space program, the Syracuse 1 and 2 military telecommunications system to provide instantaneous and secure transmissions to commo stations located on the ground, aboard warships, and on Transall aircraft. The Defense Ministry's 1991 space budget is Fr3.1 billion. The figure is expected to increase by 17.2 percent in 1992. According to Matra, the combined cost of all programs envisaged is expected to double over time, reaching about Fr6 billion per year by the year 2006.

Cost Problems With EFA Subsystems Revealed

92WS0100A Stuttgart FLUG REVUE in German
Oct 91 p 45 (box)

[Box by K. Schwarz: "Cost Problems With EFA Subsystems"]

[Text] After the trouble about the order for the radar, the participating countries are again having a very hard time selecting two additional pieces of equipment for the Jaeger 90 (EFA [European Fighter Aircraft]). Because of

significant cost problems, the actually long overdue decisions on the DASS (Defensive Aids Subsystem) and the IRST (Infrared Search and Track System) have still not been made.

The Federal Republic of Germany, which cannot afford any price increases in this project which has always been controversial, has now done something about it. It is refusing to participate in the development of the IRST and has also rejected the industrial bid for DASS, because it was far from acceptable in terms of costs and performance.

However, this is far from meaning that the Luftwaffe's EFA's will have to do without the two systems, which, according to general estimations, will contribute decisively to the success of a fighter plane in air combat. In the case of the infrared sensor, Germany has the option of adopting the device developed by the other countries.

It will, however, not be obtained at the same price as for Great Britain, Italy, or Spain, but rather a surcharge will have to be forked over—ultimately the development costs have to be recouped somehow. Thus, this amounts to a postponement of the expenditure.

The case of the DASS is a different matter. Here, with the Eurodass Consortium (Telefunken System Technik, Marconi Defence Systems, Elettronica, and Inisel), so far there is only one bidder. It is hoped that with a new call for tenders with comparable specifications, there will be more competition, even from companies in France or the United States. The objective is to arrive at a better cost-performance ratio within the prescribed cost framework.

There is a great deal of leeway precisely in the area of electronic conduct of combat operations depending on what specifications are established: Is one satisfied with a radar warning receiver, ?Dueppelwerfer chaff throwers and ?Fackelwerfer flares, or is it necessary to also have active interference systems, and how closely should all this work with the other systems of the aircraft?

Electronics firms which might be interested do not have much time to find answers to these questions. In roughly three months, the results of studies are supposed to be presented so that prototype number 4 can be the first aircraft to have complete avionics equipment. It is scheduled to take off on its maiden flight in 1993.

Italy: Conference Discusses Military Applications of Research

92MI0158 Rome AIR PRESS in Italian 20 Nov 91
pp 2325-2327

[Text] "Scientific and military research must find common interests and goals so that they can work together to make Italian technology competitive worldwide." The statement was made by the Under Secretary for Scientific and Technological Research Learco

Saporito at the conclusion of a seminar entitled "Scientific Research in the Military Sector" held by the Institute for Defense Studies and Research (ISTRID) at the Rome Center for Advanced Military Studies on 14 November. According to Under Secretary Saporito the military sector should be represented on the CIPE [Interministerial Committee for Economic Planning] and CIPT [Interministerial Committee for the Coordination of Industrial Policy] committees to overcome the obstacles and hesitations that currently restrict military research. Furthermore, given the limited funds available, synergies should be sought in the aerospace sector to avoid duplicating efforts. Military research accounts for about 7 percent of the 1.66 trillion lire allocated for research and 1.4 percent of GDP. Saporito also recalled that his ministry had promoted "a major comparison" between the Ministry of Scientific Research and the aerospace industry. Finally, Saporito urged industry representatives attending the seminar to have more faith in military research in order to define a space research program because: "Government cannot be expected to bear all costs in this field."

The meeting was opened by ISTRID chairman Paolo Vittorelli who emphasized the great importance that this issue has for Italy in general, and for the defense administration in particular, and urged the government to adopt appropriate measures in this area. General Luciano Meloni, defense secretary general and national director for armaments, who was the first to take the floor, divided his speech into two parts. He began by outlining the status of scientific research in the military sector since the end of World War II by tracing the most significant events that marked the establishment of the proper research facilities such as: the conversion of the Center for the Military Applications of Nuclear Energy (CAMEN) into a Center for Research, Tests, and Studies on Military Applications (CRESAM) in 1985; the upgrading of the Italian Air Force's (AMI) Experimental Flying Squad (RSV); the reorganization of the army's Military Technical Centers; the establishment and subsequent modifications to the Department of Defense's Technical and Scientific Committee (CSTD); and the attribution of special functions in this area to the National Director for Armaments (DNA), with the simultaneous launching of basic and applied research programs and an increase in similar activities at the industrial level. However, he added that in retrospect military research policies and the coordination of national research policies were not clearly defined during the above-mentioned period. According to General Meloni the initial R&D phase carried out by the military in close cooperation with industry under CTSD's guidance, was followed by a second phase. In this phase, scientific research in the military area, which is officially directed by the Chief of Staff and coordinated by the DNA, continues to be penalized by the lack of well-defined military research objectives and an inadequate coordination of military and civil research activities. In his brief outline of research funding, General Meloni emphasized that the three branches of the armed forces

can decide independently on the yearly allocations for modernization and upgrading. In recent years they have shown a particular interest in military research, for which they have allocated a growing proportion of their budgets. These funds are added to those budgeted under the joint armed forces research chapter. Therefore, the overall funds that the defense sector allocates to research include the sums allocated by other ministries to companies involved in military production.

In the second part of his speech, General Meloni listed the provisions that he deemed necessary for a more effective research policy, in light of the new geostrategic scenario, the reduction in defense budgets, the new single market, and the ability of national defense industries to use leading-edge technologies. According to Meloni, the time has come for the Ministry of Defense to make choices as to research investments. He pointed to the growing need for participation in large-scale multinational programs, and specified that these choices, which should lie at the very foundation of military research policies, could only be enacted after political, industrial, and other problems had been faced by the defense administration.

The political issues that can only be dealt with by parliament and government, include a need for adequate funding, the immediate approval of the new defense model and with it the act on the high ranks of the military, and closer coordination among the ministries involved in scientific research to be coordinated by the Technical Operational Committee provided for under law and chaired by the scientific research minister. The speaker noted however that no defense representative is envisaged for either this committee, or CIPI or CIPE, which he considers to be advisable.

On industrial problems, General Meloni pointed out that Italian industries pursue short-to-medium term investments. According to Meloni, pursuing a manufacturing policy that does not include research activities would be serious hence the need for government to give the priority to funding companies in this sector. This would, among other things, keep Italy in the mainstream of European technological, economic, and industrial developments. In addition, the defense industry should be further streamlined as soon as possible to achieve the critical mass needed for European competitiveness in technology and production.

General Meloni referred to the principal measures that would solve some problems within the Ministry of Defense, and which comprise: a well-defined research policy in the military area, upgrading the functional structure and staff of the Ministry of Defense's General Secretariat to meet new and more challenging tasks, transferring CRESA from the General Staff to the Office of the Secretary General and a more rational integration of military research and testing centers; upgrading the technical corps, upgrading the activities of technical

centers, and concentrating the management of all defense funds for scientific research under the Secretary General and the DNA.

National Research Council (CNR) chairman Luigi Rossi Bernardi highlighted Italy's well-known inability to develop scientific research, as is clearly demonstrated by the small yearly allocations. Professor Rossi Bernardi noted that, unlike a great number of countries which have provided for special military agencies, Italy lacks a coordinating body for research activities in the defense sector. Rossi Bernardi then highlighted the need to "equalize the military and civil sectors and pointed to an agreement on scientific research between the CNR and the Ministry of Defense that is still pending approval."

Enrico Gimelli the managing director of Alenia, addressed the entire subject by recalling that: "Military scientific research is the driving force of developments in the defense industry," which in turn is "a decisive leading factor for the development of the entire industrial system in most advanced countries." Gimelli noted that defense applications "have greatly innovated technologies and applications with impressive achievements and spin-offs" even in very diverse civil sectors. Mention was also made of the economic impact that military R&D activities have on companies that carry them out. Indeed, the latter gain a competitive advantage that allows them to operate on other markets, too. In this connection, the case of the aerospace industry, in which the military sector accounts for over half the total activity, is particularly significant and enlightening. The preceding general picture was described by Gimelli with the help of diagrams and tables and illustrated, among other things, R&D funding in a large number of countries. Gimelli then examined the opportunities and restrictions of the Italian system and reached the conclusion that high-technology industries are not as influential as their counterparts in more industrialized countries and that research suffers from dispersion, lack of coordination, and inadequate targeting and planning. His conclusion was that, given the situation, high-technology industries in the defense area can play their strategic role only if the following specific conditions are met: the long-term planning of defense requirements; the definition and implementation of an industrial policy geared to the development of existing potentials, timely participation in international R&D programs; the development of dual-use technologies; and the consolidation of relations among the Ministry of Defense, universities, and other research centers.

Fiat S.p.A. [Incorporated] Central Director Carlo Callieri emphasized the importance of upgrading military research given its possible civil returns. He also stressed the need to avoid separating the civil and military areas, and to avoid any dispersions of efforts in these sectors. Finally, Callieri stated that: "R&D initiatives could not be isolated" and stressed the need for government initiatives in this area.

In their speeches, ISTRID members Honorable Giuseppe Zamberletti and Pasquale Bandiera, as well as Army's Chief of Staff General Goffredo Canino, all basically agreed on the absolute need for increased R&D funding in the military sector. However, as General Canino pointed out, there is a risk of not having enough people to operate new and more sophisticated equipment if the personnel cuts envisaged by the new defense model are enacted.

ENERGY, ENVIRONMENT

EC Environmental Policy Assessed

Policy in Single Market

92AN0050A Antwerp DE FINANCIEEL-
EKONOMISCHE TIJD in Dutch 23 Oct 91 p 14

[Article signed K.V.: "Europe Cherishes Ambition To Become World Environment Trendsetter: Environmental Policy and the Single Market—Two Cargoes Under One Flag"]

[Text] Brussels—The establishment of the Single European Market and the conducting of a separate European Community environmental policy do not necessarily go together. The EC Commission has in the last few years been very busy trying to combine both aims in a well-balanced manner.

The Treaty of Rome (1957) does not once include the word environment. The first initiative toward a European environmental policy came at the end of 1973. The then state and government leaders announced at the end of a summit conference in Paris that "economic growth is not an objective in itself" and that attention must also be paid to protection of the environment and to the quality of life. One year later, this policy was translated into the First Environmental Action Program.

The EC only officially set up a separate environmental policy in the European Act of five years ago. This laid down that EC Commission proposals must be based on high environmental standards. Such a formula offered a base on which to build a more ambitious policy than the lowest common multiple of the environment standards of the member states, which up until then had been the rule.

Nevertheless the same European Act also put a brake on the environmental policy of the Twelve. Only those draft measures which relate to the unification of the European market may be carried through with a qualified majority of votes. Purely environmental measures require unanimity. In that event, the lowest common standards are again the result.

The European Commission, however, has succeeded in having a number of important environmental measures approved through the 1993 back door. Moreover, the

European Act stipulates that planning and decision-making in all sectors, such as agriculture, transport, energy, tourism, or regional development, must take the environment into account. In turn, this has contributed to a strong increase in environmental consciousness.

North-South

Another problem affecting European environment decision-making is pressure from the northern countries, with Germany heading the list. They often push unilaterally for stricter environmental standards. For that matter, the European Act leaves member states free to keep to more rigorous standards than the European ones.

Such differences between the member states are threatening to fragment the single market. Certain countries can, after all, ignore environmental standards or, on the contrary, go even further than the European legislation. In this way inequalities creep into the market, a situation which the European Community directives had intended to remedy. When, for instance, a member state grants a price advantage to certain products which conform to environmental standards higher than the European norm, the import of products from other countries can be impeded. Moreover, such selfish behavior by some member states places the credibility of the European environmental policy at risk.

At the beginning of this year, the EC Commission proposed a new model for environmental legislation that would provide a solution to these problems and at the same time leave scope for a more ambitious policy. As a first step the EC Commission will impose high environmental standards on all member states, based on existing technology. The second step consists of the imposition of a target standard, or a set of target standards. Fiscal incentives can be used to anticipate the first step, and also for the second step. However, no further tax advantages will be allowed to anticipate any standards other than those to be set by the European Community.

It may seem paradoxical, but by the introduction of such a two-phase approach, the EC Commission gets around the problem of a Europe moving at two speeds in the environmental field. So as to give more impetus to environmental policy matters, the EC Commission is asking that the new treaty concerning European Union would allow EC ministers to make all environmental decisions by a qualified majority of votes. Scrapping of the unanimity rule could very well raise the level of standards.

Economic Resources

The new legislative model being proposed by the EC Commission clearly demonstrates how much the method and means of environmental policy have changed over the years. The First Environmental Action Program was meant principally to plaster over the cracks. Environmental standards were harmonized in order to prevent trade barriers.

Gradually a preventive approach took its place. Rules and standards were introduced for the communal tackling of pollution at source. A prime example is the 1985 directive concerning the reporting of effects on the environment which came into effect on 3 July 1988. According to this, an inquiry must be set up into effects on the environment of large building projects such as oil refineries, chemical installations, nuclear power stations, and motorways.

Up to the end of the past decade, all EC regulations were purely administrative: the fixing of standards for licenses, limits for emissions, prohibitive regulations and restrictions. The EC Commission nevertheless seems intent on achieving more through economic and fiscal policy means. It is expected that the Fifth Environmental Action Program, shortly to be submitted, will put forward a number of basic options in that direction.

In addition, the EC Commission has also proposed the setting up of a European environmental fund, to be known as LIFE. Within a certain time this fund is to take the place of various existing subsidy schemes for the environment. In 1991-92 an amount of ECU 160 million will be made available. The EC ministers for the environment are in complete agreement about the endowment and aims of the LIFE fund.

One thing, however, is certain: The environmental policy of the EC Commission has become much more streamlined over the last few years. Where the EC was previously trailing behind in environmental areas and only went over to harmonization of standards at the wishes of the marketplace, the EC Commission at the moment clearly has the ambition to become world trendsetter in environmental matters. Its proposals point in that direction. It is, however, the member states who must approve policies and implement them. And that is something that has not always worked successfully in the past.

Footnote

In 1984 barely 11 complaints were made to the EC Commission with reference to the observance of the European environmental policy. By the end of the 80s, there were about 460 annually. Carlo Ripa di Meana, EC environment commissioner, will increasingly be buried under complaints and difficult environmental matters in the coming years.

Role of Environment Agency

92AN0050B Antwerp DE FINANCIËL-
EKONOMISCHE TIJD in Dutch 24 Oct 91 p 12

[Article signed K.V.: "Tug of War Between Member States Deprives EC of Its Main Tool for Environmental Policy; European Parliament To Sue EC Council of Ministers Over Location for Environment Agency"]

[Text] Brussels—By March 1990 all the EC policy authorities had reached agreement on the setting up of a

European environment agency. Twenty months later, the agency has still not taken shape. Now the European Parliament is considering bringing the EC Council of Ministers before the European Court of Justice.

Its Memorandum of Association states that the European environment agency will only become operational when a decision has been reached on where it should be located. Copenhagen and Madrid are the most important candidates for hosting the agency. The final decision over the siting of headquarters for the various European institutions lies in the hands of the state and government leaders of the EC. The biggest problem in this whole package is the location of the seat of the European Parliament.

During the last year, both the EC Commission and the European Parliament have repeatedly requested, without success, for cutting loose the environment agency from the total location package. The European Parliament is now threatening to put on the emergency brake. The chairman of the environment committee within the European Parliament, Ken Collins, announced last week that he was summoning the EC Council of Ministers to appear before the European Court of Justice.

Ken Collins: "The European Parliament will base its decision on Article 175 of the EC Treaty, which allows judicial action when the Council has failed to make a decision. Such a serious step as making a complaint to the Court of Justice must be properly researched. Next Tuesday the environment committee in the European Parliament will definitely decide whether to go to the Court of Justice, and with what arguments."

In EC Commission circles there have been positive reactions to the anxiety of the European Parliament to seek an end to the impasse over the question of the environment agency. Nevertheless the Commission will not directly support the European Parliament's judicial action. The EC Commission does not feel that a direct confrontation with member states is opportune at this moment.

Collection of Data

The European environment agency was set up with the aim of collecting objective and comparable data about the environment within the member states. The agency is to act as the European nerve center for the existing network of national and regional institutions. On the basis of this information the environment agency could make predictions and develop methods for controlling the impact of certain events on the environment.

At the same time the European environment agency will organize a wide dissemination of environmental data. It will cooperate in cross-border disaster plans and in the preparation of an ecological map of Europe, in which the zones at environmental risk will be classified, with indications of the nature and extent of the pollution.

Its statutes specifically state that the European environment agency will be open to membership by other countries. After the agreement that was reached this week concerning the setting up of a European Economic Area among the EC and the European Free Trade Association (EFTA) countries, the latter are certain to be involved in the European environment agency. But east European countries have also repeatedly shown their interest in taking part in this EC initiative.

The European environment agency will never be a European counterpart to the U.S. Environmental Protection Agency, the EPA. To be that it lacks real control. Ken Collins: "The environment agency will produce standards for the member states on the basis of which environmental data must be reviewed and it will ensure that standards are uniformly applied. That opens the door to coordination by the EC Commission of the national environmental inspectorates. This does not mean that the EC will have an army of green inspectors to regulate observance of environmental laws throughout the Community. Above all, the European environment agency will supervise the national environment inspectors, by watching the work methods they use."

Eco Label

In addition, following a proposal from the European Parliament, a clause has been worded into the statutes which determines how the tasks of the environment agency will be revised and possibly extended. In this way the environment agency will be given further tasks as far as supervision of compliance with EC environment legislation is concerned. After two years there is also the possibility that the environment agency will be given more power through the formulation of European legislation and European environmental policy.

One task which the European environment agency could take upon itself is the development of criteria for the awarding of an ecological label. Last year the EC Commission proposed that those products which are least dangerous to the environment should be rewarded with a green hallmark. At the moment the lack of clear criteria and procedures is hampering the discussion of the Commission's proposal. The environment agency could also play a role in the introduction of annual environmental audits for industry. The EC Commission would like to make such audits compulsory but, after persistent complaints from industry, has had to give up the plan. It is now working on a proposal for voluntary audits.

A number of pertinent questions concerning the environmental agency still remain unanswered. Collins: "To which authority will the agency be responsible? Who will control it? How will the agency's budget be calculated, and who will guarantee that budget? Who will determine its program and under what conditions?"

Global Climate Change

92AN0050C Antwerp DE FINANCIEEL-
EKONOMISCHE TIJD in Dutch 25 Oct 91 p 14

[Article signed K.V.: "Development and the Environment Become the EC's Challenge to the World"]

[Excerpt] Brussels—European environmental policy is looking outward across the borders of the EC market. The Twelve are approaching the problem of climatic changes on Earth from the ideology of long-term development throughout the whole world. The EC intends to play a leading part at the conference on the world's climate which is to be held in June next year.

The General Assembly of the United Nations decided in December 1989 to call for a UN summit on development and the environment. The aim of such a world summit will be to develop strategies and measures which will prevent further deterioration of the environment and at the same time to propel countries on the long-term and environmentally friendly development. This world summit will take place in June next year in the Brazilian city of Rio de Janeiro. Heads of state and government leaders from more than 150 countries will be attending.

It is hoped that a Charter for the Earth can be signed in Rio. The charter will contain general principles for the protection of the world's environment. Above all, attention will be paid to the problem of climatic changes. At the same time it is hoped that participating nations will be able to draw up a timetable for the 21st century, with practical and concrete programs for the protection of the environment.

Three preparatory meetings have already preceded the summit in Brazil. The last of these took place in Geneva at the beginning of September. In March a final preparatory session will be held in New York. Expectations are high, but positions still lie miles apart.

There is, for instance, the disagreement between Europe, which is pressing for change, and the United States, which does not want to take up any commitment. The United States is responsible for 22 percent of the total emission of CO₂. So far the U.S. Government has taken refuge behind the argument that there are too few scientific details available on the greenhouse effect to restrict the emission of CO₂.

The EC has decided to stop the production of CFC's completely by 1997. In October last year, the Twelve reached agreement that emission of CO₂ should be frozen at its present levels by the year 2000. In this, the EC has been supported by the members of the European Free Trade Association (EFTA). A few weeks ago, the Commission proposed a package of measures to limit such emissions and at the same time increase energy efficiency. One of these measures is the levying of an energy tax. This tax will increase according to how much more CO₂ is being emitted by the energy source.

North-South

The most important gap at the world environment conference will undoubtedly be that between North and South, the rich industrial countries and the poor developing ones. The affluent countries, which are the largest polluters, are pressing for strong environmental standards. However, it is the developing countries which will have to bear the heaviest costs for cleaning up the planet. They will, for instance, have to ensure that the rain forests are preserved. Any strict regulation will hold back their industrial development. For that reason, the poorer countries have in the past repeatedly pressed for major technical and financial assistance from the West.

In preparation for Rio, the EC Commission has prepared a discussion document which has already been positively received by the EC Ministers. It makes a plea for parity between economic growth and environmental protection, on regional, national, and global levels. According to the Commission, the closing declaration at the world conference must above all keep to the middle path between the aspirations of the undeveloped and the developed nations.

The EC is prepared for far-reaching scientific and technical cooperation with the developing countries, including transfer of ecologically justifiable technology. According to the Commission document, the industrialized world may be obliged to put extra government and private funds at the disposal of the Third World in order to enable them to tackle environmental problems.

The European Commission requests that 0.7 percent of gross national product should go from the rich countries to the developing countries. In those countries belonging to the Organization for Economic Cooperation and Development (OECD), that was on average only 0.35 percent in 1990. That money must be explicitly used for projects which contribute to long-term development. In particular, financial assistance should go only to those countries which show a clear commitment in that direction by, for instance, signing international conventions. In addition to direct support, the EC Commission's discussion document calls for debt relief. In this way, the Third World and the countries of East and Central Europe can make more use of their own funds for protection of the environment. [passage omitted]

Brinkhorst Interviewed

92AN0050D Antwerp DE FINANCIEEL-
EKONOMISCHE TIJD in Dutch 26 Oct 91 p 14

[Interview signed K.V. with Laurens Jan Brinkhorst, director-general for environmental affairs in the EC Commission, "Laurens Jan Brinkhorst Believes in a More Far-Reaching Integration of the Environment into the EC Policy; Enlarged Europe Will Have Stricter Environment Standards"]

[Text] Brussels—"Five years ago, the integration of environmental policy within the rest of EC policy only

existed in imagination. Now it is becoming a reality." An interview with Laurens Jan Brinkhorst, director general for environmental affairs in the EC Commission, concerning the environment within the European Economic Area, the Fifth European Environmental Action Program, the use of environmental levies, and the European environment budget for 1992.

TIJD: What does the creation of a European Economic Area mean for the EC's environmental policy?

Brinkhorst: The countries of the European Free Trade Association (EFTA) are well known for their very clear-cut environmental policies. This will exert great pressure on the EC to adopt and maintain even stricter environmental standards. The fear that sometimes is expressed, that a larger European common market will be bad for the environment, is thus groundless. The pressure which the northern European member states place on their southern neighbors to adopt stricter environmental standards is indeed only worthwhile within the EC framework. Without the EC, those countries would not give the environment the same priority.

TIJD: To what extent will consultation take place over future European environmental policy?

Brinkhorst: It will certainly not be easy to manage a community of 19 members. The agreement already reached on the European Economic Area stipulates that consultations must be held with the EFTA countries prior to any definite decision being made. A very complex decision-making procedure has been worked out. The EC Commission is playing a central role in all of this.

TIJD: How far is the realization of the internal market on environmental policy?

Brinkhorst: The internal market involves a number of extra challenges. For instance, strict regulations must be introduced for the transport of chemical materials and toxic products. The European market cannot become a free dumping ground for foreign waste. We have clearly not been able to solve all our problems yet. Notable is, however, the changed attitude of the member states toward European environmental policy. Weight within the EC now lies largely on the side of the progressive member states in environmental matters, whereas five years ago these still formed a minority. For me that is the clearest proof that the internal market will sooner be a stimulus for the environment than a threat.

TIJD: Will the European Political Union Treaty make the decision-making on the environment easier?

Brinkhorst: The EC Commission has put forward a proposal that all decisions on environmental matters could be taken by a qualified majority. In the future, we must apply the alternative principle, that is, we should allow more decisions to be made on the local or regional level, even if only from the point of view of available personnel and finances. Most member states, however,

still lack a political mind-set which accepts that a new government has come into existence, with a separate authenticity and a democratic legitimacy. That is why I am urging for a strengthening of the powers of the European Parliament.

Control Powers

TIJD: How is the Belgian state reform seen from the European environmental policy viewpoint?

Brinkhorst: In every mature federation there is a compelling necessity to carry legislation into effect. The main problem as far as the present Belgian state structure is concerned is that the regions are required to apply any European law while under the Belgian constitution the central government has no powers to force the regions to carry it into effect.

TIJD: Is not such a possibility for sanctions also necessary at a European level?

Brinkhorst: I believe that we will be much further forward within five years on the question of European inspection and control. However, such control will always have to take place in cooperation with national controls. We are not in the process of becoming a European superstate. The only authority which can carry out controls at the European level is the EC Commission.

TIJD: When will the European environment agency be able to start its work?

Brinkhorst: The obstruction of the European environment agency is a sad affair. The East and Central European countries are crying out for guidance and a healthier economy. The environment plays an important part in this. The European environment agency will be one of the first really integrated structures in which these countries can fully participate. If European government leaders are unable to reach a decision before Christmas over the location of the environment agency, then the EC Commission itself will have to make the decision. We will not allow ourselves to be led like this any longer.

TIJD: What role can the EC play at the world climate conference in Rio de Janeiro?

Brinkhorst: Within the Community we have the same North-South problems which exist worldwide. If we, within the Twelve, are in a position to find the formulas and instruments which create equality, then we can also try them out internationally. That aspect stands apart from the fact that, due to our colonial history, we have links with all parts of the world. Portugal will be chairing the EC at the moment we are meeting in Brazil.

TIJD: Is the EC Commission planning to introduce an environmental audit within industry?

Brinkhorst: We will shortly propose a directive for a voluntary audit. But if companies carry out such an audit, it must adhere to the guidelines of the directive. We believe that in this connection the principles of

competition will play a part. If you are a company which does not carry out an audit, you will easily be seen to be in a bad light. That creates a certain pressure. The larger companies are already convinced on this point. They see such an audit as a management instrument. It now remains to extend such awareness to small and medium-sized companies.

Action Program

TIJD: What will be the priorities in the Fifth Environmental Action Program which will be presented by the EC Commission at the end of this year?

Brinkhorst: Central to the new action program is the integration of environmental policy, both quantitatively and qualitatively, within all other policy sectors. Other elements of EC policy must thus be guided by environmental considerations. In addition to issuing regulations, we shall also make use of market means, education, and the like. Important in the Fifth Action Program will also be the principle of shared responsibility. We must get rid of the idea that government looks after the environment. Previous action programs were mere lists of suggested regulations. The Fifth Action Program has to become the bible for good behavior in the future.

TIJD: Will there also be taxes on the use of other environmentally sensitive products following the levy being made on CO₂ energy use?

Brinkhorst: In the industrialized world we must levy lower taxes on labor and capital and higher ones on resources and factors that disturb the environment. We have to see nature, as it were, as a third factor in production. At the moment the EC Commission is working on proposals for a levy on refuse and a European tax on the use of water. Water is a strategic commodity. Countries where there is a threat of water shortage and desertification, such as Spain, Italy, and Greece, use on average five times as much water per head of the population as in the north, particularly for irrigation. The cost of the water is often too low, so that too much water is extracted. We have got to take that problem seriously within the EC. The growing population in the southern part of the EC and in North Africa will have less and less water available to them.

TIJD: Does the EC budget provide enough money for the environment?

Brinkhorst: There are limits to the management structure. You must not put yourself forward as being better than you really are. In the last five years the EC budget for the environment has gone from ECU 15 million to ECU 120 million. Personnel numbers within the EC environment administration have grown from 150 to 400. These resources must be well managed. I would also like to be an economic manager. Above all, the EC Commission believes in the principle of "the polluter pays." Finally, the member states also have responsibilities in this connection.

EC Approves Energy Efficiency, CO₂ Emission Programs

92WS0167D Brussels EUROPE in English
30 Oct 91 p 12

[Article: "(EU) Energy Council: Adoption of the 'Save' Programme, Discussion of the Reduction of CO₂ Emissions (With Misgivings About the Proposed Tax) and of Procedures To Deal With a Supply Crisis"]

[Text] Luxembourg, 29/10/1991 (AGENCE EUROPE)—After a report by Mr. Cardoso e Cunha on the common market of electricity and gas, the Energy Council held two general debates and adopted the programme designed to improve energy efficiency. Details follow.

A) Strategy for the reduction of CO₂ emissions. The Commission's proposals (including the proposed tax) which were given a favourable reception by the Environment Council, raised various concerns in several delegations, although the proposal is deemed warranted by the very great majority. Germany agrees with the principle of the tax, but takes the view that its level and progressive implementation merit further study. This delegation would have preferred a tax exclusively affecting emissions of CO₂, a solution which would correspond more clearly to the "polluter pays" principle. France takes a view along these same lines, but some Mediterranean countries (Spain and Portugal in particular, but not Italy) fear that the introduction of this tax may slow their industrialization.

Work on this text will be pursued in the joint environment/energy working party (and with the aid of tax experts) in preparation for the joint sitting of the Energy and Environment Councils scheduled for 10 December in Luxembourg.

B) The SAVE programme. The Council approved without debate this programme concerning the promotion of energy efficiency in the Community. With a budget allocation of 35 mecus for the five-year period (14 mecus of which for 1991-1992), this programme is aimed at providing Community support for a series of measures in the area of energy efficiency, including:

- technical evaluations of the data necessary for the definition of technical standards;
- support for national initiatives aimed at enlarging or creating infrastructures;
- encouragement of the creation of an information network;
- measures for the implementation of the 1989 programme designed to promote more efficient use of electricity.

The Council also discussed the first measure in application of the SAVE programme concerning yield requirements for new hot water boilers using liquid or gas fuel.

Several technical aspects of the proposed directive on this matter are in dispute. The objectives of this directive are both to save energy and guarantee the free movement of boilers through the harmonisation of standards, without neglecting environmental protection.

C) Measures to deal with an oil supply crisis. Following debate, the Council was expected to approve conclusions on Tuesday evening laying down guidelines for new procedures to be introduced and urging the Commission to revise its proposals. EUROPE will provide a full report tomorrow.

European Environmental Policy Faces Problems

92MI0132 Bonn DIE WELT in German
21 Nov 91 p 23

[Article by Anatol Johansen; Environment Minister Toepfer Fighting on Three Fronts, Poor Outlook for Earth Summit"]

[Text] Planning for the Earth Summit in Rio in June 1992, at which a number of environmental agreements are scheduled for signature, is proceeding painfully slowly, according to a statement just made by Federal Environment Minister Klaus Toepfer in Sydney, where he is canvassing for support for his policies. He feels there is at present "a resigned wait-and-see attitude, rather than a dynamic forward push," which he blames partly on the results of the Gulf War, and partly on American and Japanese attitudes. He thus finds himself fighting on three fronts to prevent the conference from failing.

Germany has already committed itself to reducing carbon dioxide emissions by 25 percent by the year 2005, and is thus setting the pace for the rest of the world to follow. The German cabinet is to receive an interim report on 11 December setting out the progress these efforts have made so far and proposals for further advances. Toepfer has also reported his disagreement with Trade Minister Moellemann, who has presented an energy program that Toepfer considers is incomplete and made up of "a few well-sounding sentences strung together."

Toepfer would like to make energy more expensive and force major polluters, such as coal- and oil-fired power stations, to find a "solution for emissions." The newly united Germany is, after all, adding to environmental pollution through its annual emissions of a billion tonnes of carbon dioxide: Before the new laenders' accession, the total was 700 million tonnes.

This is the general CO₂ situation in Germany, but Toepfer also has to do battle on a European level. He would like to commit the European Community to maintaining carbon dioxide emissions at their 1990 level, without any further rise to the year 2000. So far,

however, only the Netherlands and Denmark have followed Germany's commitment to reducing CO₂, while all other European countries are still standing on the sidelines.

In addition, countries such as Greece, Portugal and Spain, which have still to reach German, French, and British levels of industrialization, insist on raising their CO₂ emissions even further; certain countries thus need to reduce their CO₂ levels really drastically so as to prevent any further rise in the amount for Europe as a whole.

A so-called "jumbo council" of European ministers with responsibility for the environment, energy, and finance will be held in Brussels on 12 December with the purpose of achieving European agreement on this matter. Meanwhile, however, European industry is already lobbying energetically against such proposals, pointing out the substantial competitive disadvantages that they would suffer if these environmental conditions were to be imposed solely on Europe, but not on international competitors.

Toepfer is facing difficulties not only on a national and European level, however, but internationally as well. Planning for the conference is in the hands of three different bodies: a planning committee, two international negotiating committees, and a conference secretariat set up by the UN in Geneva and headed by the Canadian Maurice Strong.

For all that, however, the international will to make the conference a success that goes beyond non-binding declarations, is still distinctly lacking, and not only on the part of the group of seven leading economic and industrial countries (the G7 group), which it is Germany's turn to chair from January 1992. (The next economic summit will take place in Munich, though unfortunately not until July 1992.)

The OECD, which provides a forum for cooperation between industrialized western countries, from Canada to New Zealand, also remains far from reaching agreement over implementing the aims of the conference. The next meeting of OECD members will be held in Paris on 2 and 3 December, when Toepfer and his colleagues hope a positive decision will be reached.

Finally, the developing countries fall into several distinct categories where the earth summit is concerned. Those belonging to the Organization of Petroleum-Exporting Countries (OPEC) have, quite naturally, little interest in reducing energy consumption and, hence, CO₂ emissions. The largest group, comprising the poorer developing countries, whose per capita CO₂ emissions amount to only a few percent of those of the industrial countries, would view any requirement to reduce CO₂ emissions as a restriction on their economic development.

Finally, a major obstacle continues to be the fact that a few months ago the world's major CO₂ pollutant by a

large margin, the United States, informed Toepfer in Washington in a manner verging on the brusque that it could not make life even more difficult for its economy, many sectors of which were already hard-hit, by accepting requirements to limit CO₂. Such an attitude also has implications for many other countries that take their lead from the U.S. This is why Toepfer is currently in Asia, Australia, and New Zealand, where he is lobbying for his environmental policies in advance of the earth summit. At least Australia and New Zealand are not turning a deaf ear, as they too want to reduce their CO₂ emissions by 20 percent by the next decade.

France: CNRS Restructures Environment Research Program

92WS0111B Paris AFP Sciences in French
17 Oct 91 pp 42, 43

[Article: "CNRS Gives 'New Push' to Environmental Program"]

[Text] Paris—The National Scientific Research Center (CNRS) has decided to give a "new push" to its environmental program by creating new local and regional centers that will collaborate with other laboratories and research organizations.

Announced at an 11 October press conference, the new CNRS initiative to "mobilize" French environmental research will focus on three broad areas: analysis of the evolution of ecosystems under pressure from humanity (atmosphere, climates, biological diversity, pollution of waters, etc.); evaluation of humanity's role in these changes; and identification of development strategies which will be more sensitive to all these problems, which technology alone cannot fully solve.

The scientists are indeed worried these days. "The human species is beginning to upset the global balance on a large scale, and this threatens his own existence," says Alain Ruellan, director of the CNRS environmental program.

CNRS therefore is going to put more effort into basic research into the environment, which will be organized around interdisciplinary teams but without "destructuring" existing laboratories. Regional research centers will be created, each concentrating on a particular area. The first four will be located at Rennes (effects of agriculture on environment and health in temperate countries), Montpellier (research in hot regions: climatic evolution, weather patterns, etc.), Strasbourg (eco-toxicology) and Grenoble (industrial risks).

In addition, Interdisciplinary Research Groups (GIDRE's) will provide a loose structure at the local level in which different laboratories can work together on smaller projects. "The idea is to improve the quality of work and encourage researchers," said Mr. Ruellan, who announced that CNRS will support this objective by launching an all-interdisciplinary journal devoted to environmental affairs, NATURE-SCIENCE-SOCIETE.

Its sponsors hope CNRS's new environmental program—replacing PIREN (Interdisciplinary Environmental Research Program), which was launched in 1978—will at all events give French environmental research more international standing. France is still "on the margins" at conferences on the subject, which are dominated by Anglo-Saxon scientists.

German Civil Court Orders Nuclear Waste Dump Closure

92MI0146 Bonn DIE WELT in German 29 Nov 91 p 5

[Article by Ute Semkat: "Toepfer's Hopes for Morsleben Dashed"]

[Text] The nuclear industry's Achilles heel, the disposal of its end products, has suffered a mortal blow with the Magdeburg District Court's ruling that Germany's only permanent waste disposal site, at Morsleben in Saxony-Anhalt, be closed. The Federal Environment Ministry's hopes of having found a final solution, at least for low- and intermediate-level waste, in the underground dump taken over from the former GDR, which had operated it since 1981, seem to have been dashed, as it is uncertain when the planned permanent disposal site at Gorleben and interim store in the Konrad shaft not far from Morsleben in the red and green Land of Lower Saxony, will be ready, if at all.

The closure of Morsleben means an awkward "tailback" in research facilities and hospitals, especially as regards nuclear medicine, in the new laender, because since the court ordered a temporary cessation of dumping at the end of February they have been unable to dispose of any radionuclides, diagnostic fluids, or iodine preparations. However, most of the waste for Morsleben came from the former GDR's nuclear power stations, which are now closed. The use of interim storage facilities in the old laender, on which a decision is still pending, is bound to entail further delays.

The unexpected success scored by Helmstedt lawyer Claudia Fittkow, who objected as a private individual to the continued operation of Morsleben on the grounds that it was a health hazard, is rooted only partially in safety considerations, since the experts contradict one another on this issue, and what some see as an acute hazard others classify as "residual risk." But it is no accident that the case was heard by the Administrative Court.

Ms. Fittkow, who is a member of the Federal Association of Citizens' Environmental Protection Initiatives, found the loophole in the Unification Treaty. As the Magdeburg judges confirmed, the Federal Radiation Protection Office (BfS) has no license for Morsleben under the law on atomic energy and is therefore storing there illegally. This, according to the ruling, is because there was "no way, from a legal point of view" that the license granted to the "Bruno Leuschner" Power Station Combine, Greifswald, on 22 April 1986 to operate its Morsleben plant permanently could be said to have been assigned

with it when the permanent disposal site passed from GDR state ownership first to the GDR State Radiation Protection Office and then to the BfS.

As opposing party, the Federal Office countered that, under the Unification Treaty and the framework law on the environment in force since 1 July 1990, all licenses for "other atomic installations" issued in GDR days remain valid for 10 years. The authorities will continue to hold this view according to a statement from the Federal Environment Ministry yesterday. They were considering whether to "lodge an appeal on a point of law" and whether to take "other or additional initiatives."

Germany: Phosphates Removed From Sewage by Electromagnet

92MI0126 Bonn DIE WELT in German
14 Nov 91 p 23

[Article by Ernst-Ludwig von Aster: "Electromagnet Fishes Phosphates Out of Effluent"]

[Text] "Nobody tampers with creation with impunity," thundered Tron Tronsen, dean of Trondheim cathedral, three years ago. It was a tiny organism measuring only one-hundredth of a millimeter, *Alga Chrysochromulina polysepais*, that was making him see red. In the spring of 1988, this species of algae had proliferated out of all proportion and triggered an ecological disaster in the coastal waters of northern Europe. In large areas of the Skagerrak and the Kattegat, all life down to a depth of 12 meters was suffocated by a layer of algae up to 20 meters thick. Marine biologists were in no doubt as to the cause of this algae explosion: excessive fertilization of the sea by nutrients. Year after year, 100,000 tonnes of phosphates and 1.5 million nitrogen compounds were washed into the North Sea alone, almost doubling the phosphate content of the German Bight since 1962. In order to stop the stream of nutrients from FRG waterways, the federal government took emergency steps in 1989 and laid down a limit for the level of phosphorus leaving sewage plants. Large sewage plants serving more than 100,000 inhabitants are allowed to discharge only one milligram of phosphate per liter, whereas two milligrams are tolerated at smaller plants.

Phosphate Pollution Must Be Reduced

The Environment Ministry hoped that overall, this would halve the approximately 60,000 tonnes of phosphate discharged yearly by the sewage plants into waterways. A new era dawned for sewage plant operators. Previously, their main concern had been to deal with pollutants in sewage, but the nutrients had to be eliminated. Carsten Ross of Federal Environment Agency (UBA) estimates that 25 percent of the pollution of the original federal lands are already connected to sewage plants equipped for phosphate elimination. To the UBA expert's knowledge the remaining sewage plants are working to achieve phosphate elimination, as those who fail to control the level of phosphate discharge from their

sewage plants will have to pay next year. For every three kilograms of nutrient salt, 50 German marks will be charged in sewage duties.

The Siegen-based firm Rotamill has now developed a new phosphate elimination procedure designed to keep phosphate levels well below the legal limit. The company uses an electromagnet from the product range of a Dutch transformer manufacturer to get the better of unwanted phosphates in sewage.

For the electromagnet to cut phosphate pollution to less than 0.5 mg/l, the sewage must be pretreated—as in conventional methods of phosphate elimination. After going through the mechanical and biological cleansing stages in the sewage plant, the phosphate dissolved in the effluent is converted into compact particles by adding a precipitant such as lime or aluminum salt. Whereas some sewage treatment plants currently use large filter units to extract the phosphate flakes, in future the much smaller electromagnet will do the job, if Rotamill has its way.

Magnetite performs a key function. One kilogram of the fine-grained ferrous mineral per cubic meter of sewage is added as a magnetic medium. Water-soluble polymers are also added to facilitate flocculation, the formation of macroflakes from the precipitated phosphates and the magnetite.

After one or two minutes in the flocculation pipe, the magnetic medium is incorporated into the phosphate flake, and the pretreated effluent then flows through the electromagnets. The magnetite-phosphate flakes cling to a metal grid installed in the magnetic field as a retention surface. When the separation chamber is 70 to 80 percent full of magnetite-phosphate flakes, the electromagnet is switched off and the chamber is rinsed out. The purification process then continues. A downstream process recovers up to 99 percent of the magnetite from the phosphate mud, after which it is reused as a magnetic medium.

Sewage Plants Continue to Favor Filters

The magnetic water treatment system has already been given an initial test run. The process was tested over a five-week period in the research sewage plant at the University of Stuttgart's Institute of Domestic Hydraulic Engineering, Water Quality, and Waste Management. Professor Ulrich Rott, who was in charge of the tests, expressed initial scepticism when he inspected the mobile pilot plant. After all, there were no references to magnetic phosphate elimination in the relevant literature. The maiden run nevertheless went off successfully. Previously cleansed effluent from a Swabian sewage plant with a phosphate content of between 2.5 to 4.0 mg/l was purified by a magnet to 0.2 mg/l.

However, sewage plant operators in the Federal Republic still remain sceptical about the new process.

Most continue to favor conventional flocculation filtration, where the flocculated phosphate is retained by large filter units. Rotamill still has another arrow to its bow, however: According to engineer Eberhard Krumm, this method could be used for problem-free elimination of metals and heavy metals from industrial effluent.

Germany: BMFT Funds Electrolyzer Project

92MI0068 Stuttgart *LASER UND OPTOELEKTRONIK* in German Oct 91 p 17

[Text] With funding from the BMFT [Ministry of Research and Technology], the High-Performance Generating Electrolyzer Company (GHW) in Putzbrunn has developed a system that divides water into oxygen and hydrogen with 85 percent efficiency. The system is also designed for both continuous and intermittent service, so forms of energy that are not available on a constant basis, as is typical of the sun and wind as renewable sources of energy, can also be converted into hydrogen energy, which can be stored.

The core of the high-performance electrolyzer is the composite electrode-diaphragm-electrode (EDE) unit. The process used to produce this composite oxide ceramic unit is currently being developed for mass production. The outstanding feature of this new process is that both the ceramic diaphragm and the two electrodes (anode and cathode) of the electrolyzer can be produced in a single manufacturing process. Ceramic and metal oxides in powder form are cheap raw materials. The foil-like EDE composite makes it possible to keep the distances between the electrodes extremely small. This makes the electrolyzer very compact while maintaining a high performance-to-volume ratio. Initially, the company intends to run a prototype in the kilowatt range. It then plans to design a demonstration plant in the megawatt range. This design will then be built in the vicinity of a power station and tested.

Luz Power Station Closure Said to Jeopardize European Solar Energy Projects

92MI0147 Bonn *DIE WELT* in German
29 Nov 91 p 14

[Excerpts] The world's biggest developer of solar power stations, the American Luz International, is finally throwing in the towel. Board Chairman Newton Becker said in Los Angeles that the reason was lack of support from the U.S. government. They had had to compete against atomic power and conventional energies on unequal terms.

Back in August this year the over 400 creditors, including Flachglas Solartechnik [Sheet Glass Solar Engineering] of Cologne and the Swiss firm Asea Brown Boveri (ABB), sought ways to save the firm, but in vain. But Flachglas manager Joachim Benemann has now said that the German Flachglas Group is prepared both to guarantee spare parts supplies for existing plants and to work on the building of new plants jointly with European

and American partners "in the event of a change in the financial and administrative conditions."

His appraisal of the likelihood of building the pilot solar plant at Almeria in Spain, involving, apart from Luz, the German Aerospace Research Establishment, Flachglas Solartechnik, and the Spanish energy authority Clemat, is negative. The Federal Ministry of Research and Technology had held out the prospect of its contributing 20 percent to the total 100 million German marks cost. For Joachim Benemann it is "all or nothing." Should the Almeria project fall through, a solar power station that was also planned with Luz in Brazil founders, and no new plants be planned for California, not only his company but also its unique know-how would be in serious jeopardy.

Germany to Fund Biomass-Fired Heating and Power Stations

92MI0115 Bonn *TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN* in German
28 Oct 91 pp 7-8

[Text] The Federal Ministry of Research and Technology [BMFT] is to fund a limited number of biomass-fired heating and power stations yielding outputs between 1 MW and approximately 40 MW. The aim of this funding is to demonstrate the economic viability of these installations in terms of specific sites, firing techniques, and plant size, and to provide evidence that will have general validity for Germany. To fund this new model, over the next three years the BMFT is providing an approximate total of 30 million German marks [DM], which is earmarked, for the following main reasons, primarily for projects in the new laender:

- The new laender possess large, concentrated areas ideal for viable biomass production.
- There are also large areas of polluted ground, especially in Brandenburg, that are unsuitable for food production and therefore have to lie fallow.
- In contrast to the older laender, there are widespread heating grids, which could receive stored power on a viable economic scale between 1 and 40 MW.
- There are a large number of power stations, especially smaller ones, requiring conversion from brown coal with its high sulphur content to other energy carriers, such as biomass, for environmental reasons.

A large number of pilot projects to generate power (heat and electricity) from biomass (wood, straw, ramie [Chinaschilf]), located at specific sites, e.g. in Mecklenburg-Vorpommern, Brandenburg, Lower Saxony, and Schleswig-Holstein, will provide information relating particularly to the economic viability of operating such installations.

Funding will be scheduled as follows:

1. Up to 20 feasibility studies will be funded on the basis of outline submissions.

2. On the basis of these feasibility studies or equivalent documentation, a maximum of six basic engineering studies (drafting of documents for tenders) on the construction of an installation will be funded.

3. On the basis of positive assessments of basic engineering projects, including consideration of their economic viability or similar criteria, the operation of up to six power stations using regenerative raw materials with an output of at least 1 MW will be funded.

These installations will be designed to be fuelled primarily by plants grown specifically as sources of energy, for example fast growing woods and grasses such as ramie; to maximize economic viability, these will, to a limited extent, be supplemented by solid vegetable residue recycled from agriculture and forestry.

On behalf of the BMFT, the Karlsruhe Nuclear Research Center's Department of Applied Systems Analysis has recently carried out a technology impact assessment study on regenerative raw materials; it reaches the conclusion that solid regenerative energy carriers hold out better prospects for providing heat than liquid energy carriers, such as ethanol, methanol, or even rapeseed oil. Liquid energy carriers generally have lower energy yields per hectare, and an unfavorable net energy balance.

In assessing economic viability, it is essential to apply a range of criteria to the various sources of energy deriving from regenerative raw materials. From the point of view of the national economy as a whole, (taking no account of taxes and subsidies) the study reaches the overall economic conclusion that the exploitation of solid fuels from regenerative raw materials for power generation can be economically viable in installations with outputs ranging from 1 MW to 42 MW, while ethanol, methanol, and rapeseed oil extracted from regenerative raw materials appear to have limited viability as motor vehicle fuels. On the other hand, from the purely economic standpoint it should be noted that, taking due account of taxes and subsidies, a breakdown of 1990 market prices for diesel fuel derived from rapeseed oil revealed that the breakeven point for the producers of 3 pfennigs per liter, and for private consumers of 9 pfennigs per liter, can already be achieved.

These new funding measures are therefore an integral part of an overall plan for the exploitation of renewable raw materials for energy purposes, involving research into the technical, economic, and ecological aspects of the use of plant oils as motor vehicle fuels or components of such fuels.

In this connection, the BMFT is funding a joint project in Mecklenburg-Vorpommern designed to develop another method for manufacturing fuels from rapeseed to the point of practical application. The project is based on the discovery that refined rapeseed oil mixed with mineral oil components can be processed in conventional "hydrotreaters" into specification-standard diesel oil. Research centers in Rostock, Chemnitz, Berlin, and Thuringia are involved in this joint project.

German Chemists' Association Seeks to Reduce Pollution

92M10078 Duesseldorf *HANDELSBLATT* in German
31 Oct 91 p 24

[Text] Scope for reducing energy consumption and new techniques for reducing environmental pollution in electrochemical processes were the major topics at last week's meeting of the Applied Electrochemistry panel of the Society of German Chemists (GDCh) in Ludwigshafen; the main emphasis was on alkali chloride and aluminum electrolysis.

Some 3.5 million tonnes of chlorine and 1.3 million tonnes of aluminum are produced each year in the older laender by these two most widely used electrochemical processes. Electrochemists consider one of their major tasks to be the development of processes requiring lower energy consumption and involving less pollution of the environment.

Despite current debate on "chlorochemistry," chlorine production is still estimated to be rising by about 1 percent annually, with chemical production remaining dependent for the foreseeable future on this intermediate process. Some 60 percent of chemical products manufactured in Germany still derive from chlorine as the base chemical.

Chemists are confident that significant improvements can be achieved in chlorine production by using the membrane process, which is being constantly refined; the technology that has now been developed will replace the amalgam process, so the pollution associated with the latter will gradually cease and the mercury emissions will be eliminated.

Experts estimate that conversion of the 13 to 15 plants in Germany operating by the amalgam process will take at least 15 years. Apart from the fact that the membrane process has only just been perfected, there was a lack of investment in this technique in the past owing to lack of financial incentive. The slight energy savings, in the order of 600 kWh/t, compared with the amalgam process did not offset the conversion investment costs, which were in the region of 1,400 German marks [DM] per tonne over many years.

However, it is believed that greater energy savings can now be achieved by using newly developed electrodes in the electrolysis of molten aluminum oxide. Though this process, in which aluminum is deposited in liquid form in energized high temperature cells on the cathode, has already reduced electricity consumption in recent years to 13,500 kWh/t, the new electrodes are expected to make a further 30 percent power reduction a thoroughly realistic target.

Intensive work is also being carried out on the electrolytic cleaning of aluminum scrap with a view to conserving raw materials, saving energy, eliminating waste, and recycling metal. This type of recycling presents no problems with copper scrap, and processes for refining lead from exhausted car batteries by electrolysis are being tested.

In addition, there is scope for electrochemical solutions to a range of problems arising from the purification of factory effluent. The best-known of these processes is the retrieval of silver from fixing baths with simultaneous retrieval of the fixing salt. Electrolytic removal of metals from effluent has the advantage over other processes that no additional substances are used.

Experts have high hopes for a new process presented in Ludwigshafen that will enable even highly polluted effluent to be purified in the future. The process is based on a new type of cathode with small-grained, porous graphite layers through which the liquid flows and in which the metals will be deposited. It will, however, take some considerable time to bring this process to technical maturity.

Chlorine Production to Employ Membrane Technique to Limit Mercury Pollution

92WS0116A Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 31 Oct 91 p 8

[Article: "Mercury Emissions Can Be Effectively Prevented With Membrane Technique"; first paragraph is FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT introduction]

[Text] Ludwigshafen—Switching to the membrane process in the production of chlorine would cost more than 3 billion German marks [DM]. The chemical industry cannot do without chlorine.

The chemical element, chlorine, is increasingly being subjected to public criticism. But the debate over the environment is focused not only on end products containing chlorine, like solvents of polyvinyl chlorides (PVC), but also the production methods themselves: In Germany chlorine is mainly produced by an amalgam process that is over 90 years old and which is over and over again giving rise to criticism by environmental protectionists because of its mercury emissions.

However, chlorine gas, which is produced electrochemically from rock salt, is one of the really most important chemical products. Without chlorine and caustic soda, which is produced by chlorine-alkali electrolysis in about the same proportion, the chemical industry would have to give up about 60 percent of its sales volume.

To produce chlorine, rock salt is dissolved in water to form a brine, freed of troublesome impurities, and dissociated into chlorine, caustic soda, and hydrogen with electrical direct current. Three different electrolysis

methods (amalgam, diaphragm, and membrane processes) today compete with one another economically and ecologically. Chemically, they achieve the same effect, but they differ in the way the chlorine that is generated on the anode is kept away from the cathode products: caustic soda and hydrogen. In Germany about a third of the annual chlorine gas production of approximately 3.5 million tonnes is produced by the 100-year-old diaphragm process. With this technique, the separation of the electrode spheres is achieved by means of a fine-pore partition that prevents subsequent mixing of the electrolysis products.

More than 60 percent of the chlorine gas, on the other hand, is produced by the amalgam process. With this process, a mercury film a few millimeters thick serves as the cathode. The liquid metal flows across the bottom of a diagonally mounted electrolyte cell and dissolves the sodium that forms initially into the form of an amalgam. In a reaction triggered after this, the sodium amalgam is decomposed with water into its essential products: hydrogen and caustic soda.

Not the end product, chlorine, but the exceptionally high volume of mercury emissions has severely discredited the amalgam process in the past. All 18 of the plants today operating in Germany emit only 0.2 grams of mercury per ton of chlorine volume. Waste Water Regulation 42 will henceforth reduce this load to 0.02 grams per ton. Since this type of chlorine-alkali electrolysis is today no longer viewed as state of the art by licensing authorities, European chlorine producers have agreed to shut down all amalgam plants by 2010. Chlorine producers defend this comparatively long period of time on the grounds of the large capital investment of about DM1,400 per ton of chlorine which the switch to the environment-friendly membrane process will require.

According to data provided by the Association of German Chemists (GDCh), whose professional organization, Applied Chemistry, recently held its annual meeting at the BASF [Baden Anilin and Soda Factory] In Ludwigshafen, total investments will probably amount to about DM3.1 billion. Then the membrane process, which is viewed as an economic method of producing chlorine and one that protects the environment, will begin. With this technique, which has up to now only been employed to a slight extent in Germany, an extremely resistant, thin sheet of plastic serves to keep the products of electrolysis apart.

By means of this technique, current mercury emissions produced by the amalgam process—annually about 4.4 tonnes—would drop to zero. With this measure, however, the total damage to the environment produced by mercury would only be reduced by about 5 percent since, according to the data provided by the GDCh, 80 tonnes of toxic metal a year find their way into the environment through the burning of coal.

Since the membrane technique saves about 25 percent in energy in comparison with conventional electrolysis, new

plant facilities employing this technique exclusively are already being installed in many countries. Converting older production plants to the membrane technique is, on the other hand, not a simple matter. Franz Rudolf Minz of the Bayer Company, among others, spoke in Ludwigshafen of the various practical difficulties.

Thus, for example, the salt solution must be liberated more carefully from the calcium and magnesium ions than before because, otherwise, they will attach themselves to the membrane and interfere with its function. To accomplish this, the brine is subjected to a precipitation process first in the course of which the alkaline-earth metal cations are precipitated from the solution as insoluble salts.

The remaining small concentrations must then be separated from it to down to a few parts per billion (ppb). To achieve this, increasingly more efficient ion exchangers are being employed. A number of methodological problems also have to be overcome in converting from the amalgam to the membrane technique. By way of example, the chlorine produced with the modern technique contains more oxygen, which has to be separated from it through an intercalated liquefaction of the chlorine.

The comparatively low concentration of caustic soda that is generated is also unfavorable; it has to be raised to the customary commercial content of 50 percent by a subsequent, additional evaporation of about 32 percent. Instead of this, the chloride content of the lye—an impurity that can sometimes become annoyingly noticeable during further processing—is less than 100 parts per million (ppm).

On the occasion of the professional organization's meeting in Ludwigshafen, the chlorine producers let it be understood that the worldwide demand for chlorine gas would further increase rather than not. They estimate an annual growth rate of about 1 percent. For this reason, it would be wise to start out with unchanged capacities during the conversion to the membrane technique. On the whole, the chemical industry will basically not be able to do without chlorine.

A third of chlorine production is already exclusively needed for the synthesis of semifinished products. This element is no longer contained in the end products because it is mostly again dissociated as hydrogen chloride (hydrochloric acid) or chlorite. Such byproducts could today be processed with a recycling technique and reintegrated into the cycling of chemical industry materials.

Chemical Industry Federation President on Chemical Pollution

92AN0069 *Groot-Bijgaarden DE STANDAARD*
in Dutch 28 Oct 91 p 14

[Article by Johan Mortelmans: "European Chemical Industry Federation Urges Members To Take Environmental Measures"]

[Text] Brussels—"Ultimately, the solution for the environmental problem depends on goodwill," says Hugo Lever, managing director of the European Chemical Industry Federation (CEFIC). "Most of our members are willing to make the effort. We try to encourage them to actually tackle these problems. And I can assure you that we are making progress." According to Lever, it is essential that all companies make a contribution, even though some of them have inevitably achieved more than others in their fight against environmental pollution.

The Brussels-based CEFIC is the umbrella organization for 15 national chemical industry federations and 44 large European chemical companies. The organization negotiates on their behalf with such organizations as the European Commission about matters concerning environmental legislation. CEFIC regularly brings the European chemical industry together to discuss environmental issues.

"The attitude of chemical companies toward the environment has changed spectacularly over the past 10 years," says Lever. "Management is now open to these problems, but needs some more time to let it all sink in."

The chemical sector is right on top of the environmental issue. Pollution is not only caused by the manufacture of chemical products, but also by their use in other sectors. Chemical products—as well as problems they cause—are extremely diversified. One example is chlorine chemistry. Some applications are very useful and practically harmless, while others are to be avoided.

Over the years, pollution control has become a major cost factor for the chemical industry. "Putting the environment high on the priority list entails higher costs," says Lever. "These are passed on to the customer." This is possible in rich countries but creates problems in poorer countries.

Lever is not questioning the necessity for rigorous environmental legislation. However, in his opinion, this does not mean that the authorities have to regulate everything in detail. Good environmental legislation should allow scope for voluntary measures, says Lever.

He refers to the Responsible Care Program that has already been signed by most of the major European chemical companies. The program does not impose a single standard. The basis of the program is that every company, regardless of its position, continually improves its achievements with regard to the environment, safety, and health. The companies supervise each other. Portuguese companies do not yet compare to the Germans, but both are currently progressing. It is important to keep ahead of the legislator.

According to Lever, the companies' independence should be maintained—also for environmental audits. These should be carried out by the firms themselves and could subsequently be checked by outsiders. No outsiders are required to perform the actual environmental

audit. Partly as a result of CEFIC's lobbying, the European Commission watered down its far-reaching proposals in this area.

The projected taxes on the use of energy and CO₂ emissions remain a bone of contention with the European Commission. The chemical industry is an energy-intensive sector and the Commission plans will unilaterally weaken the competitive position of European companies, especially versus North American firms, according to Lever.

CEFIC does not object to measures to reduce CO₂ emissions, but it thinks that taxes are not the best way. The chemical industry advocates self-regulating measures. It is more effective to encourage west European companies to invest in cleaning up the east European chemical industry than to subject them to taxes for their relatively low CO₂ emissions, according to CEFIC. If environmental levies are eventually introduced, they should be on a worldwide basis.

Cradle to Grave

What is the extent of the chemical industry's liability for the environment? "We accept that a product has to be monitored from the cradle to the grave. This is especially true for products which are sent to the Third World, such as pesticides," says Lever. "However, this does not mean that we have to accept responsibility for everything."

"We try to work together as much as possible with both buyers and traders because in the eyes of the public there is no distinction when accidents occur. However, we should not be held responsible as long as we have no control over what is happening. There is no reason why we should take the blame for someone else's mistakes."

What results have been achieved to date? According to Lever, pollution per product unit has dropped drastically over the past years; however, in the meantime, production levels have increased and it is not clear how pollution on the whole has evolved. How much environmental care is actually costing to companies is also not clear. Many environmental investments have already been recuperated as they resulted in other unexpected cost-savings. Moreover, in the case of investments in new production processes, it is difficult to determine which expenditure is directly related to environmental costs.

Technology transfer to the Third World is one of the greatest challenges in the environmental issue, according to Lever. Pollution will remain substantial as long as Third World countries continue to work with outdated technologies. For the time being, they are lacking the money to purchase the latest technologies.

Moreover, Western companies are not in a position to transfer their technology free of charge. It represents a form of property for which they have had to pay dearly. According to Lever, the only solution is that society

carries the cost of buying technology from the companies and transferring it to the developing countries.

Bayer's Environmental Efforts Described

92AN0068 Groot-Bijgaarden DE STANDAARD
in Dutch 28 Oct 91 p 14

[Article by Antoon Wouters: "Bayer's Environmental Dilemma"]

[Excerpt] Leverkusen—Bayer is faced with an environmental dilemma. Current knowledge of environment-friendly techniques is reaching its limits. Environmental costs are spiraling and will reach more than DM1 billion (20 billion Belgian francs (Bfr)) per year by the end of this century. This is nearly as much as the 1990 after-tax profits. The competitive position is under pressure as, elsewhere in the world, companies are less concerned with the environment and continue to manufacture using cheap techniques which are harmful to the environment.

However, there is no turning back for Bayer due to the company's image and because of regulations which will become even more stringent in the future. Germany wants to play a leading environmental role in Europe. Bayer is looking for a way out of its dilemma through an "integrated environmental approach," which involves the elimination of pollution at the source (during the production process) and the recycling of waste products into reusable raw materials or an energy source. However, this requires extra time and money.

Hermann Strenger stressed that environmental protection and safety are to remain cornerstones of Bayer's policy, now and in the future. For every DM6 billion (Bfr120 billion) that the company invests, DM1 billion (Bfr20 billion) is spent on environmental protection. This reduces waste streams substantially.

"Further improvements are only possible by incurring excessively high costs. An integrated environmental approach involves substantial investments, but Bayer is convinced that this approach is more rewarding in the long term than an end-of-the-pipe policy. We hope that this method will enable us to at least stabilize environmental costs and, if possible, lower them," said Strenger.

This approach is essential for Bayer if it wants to maintain its international competitiveness. DM1.7 billion (Bfr34 billion) of the DM3.7 billion investment program which was launched in 1987 has already been spent. Environment-related operating costs amounting to DM4.7 billion (Bfr94 billion) over the last four years are to be added to this sum. This is a total of more than DM6 billion (Bfr120 billion). A critical point has now been reached according to Bayer.

Referee

Strenger stresses that competitors in the world market do not have to work with such high environmental costs. In

his opinion, it is essential that environmental protection be harmonized internationally, at least within the EC and if possible throughout the OECD countries.

He would like to see an environmental policy with clearly defined objectives and straightforward standards. Standards for dioxins deviate by a factor of 1 to 10 in the EC member states. Around this time last year, the 17th Federal Law on the Quality of Air became effective in Germany. It stipulates that the maximum emission of dioxins in Germany be reduced from one millionth of a gram (1 nanogram) per cubic meter air to 0.1 nanogram per cubic meter.

The environmental policy objectives and the threshold values of harmful products should be determined scientifically. Bayer stresses the necessity of a referee, namely an independent research institute that determines the threshold values, modeled after the U.S. National Academy of Sciences or the British Royal Society.

Strenger concluded with an appeal to German politicians not to overrate the companies' financial strength. He thinks that it is not possible to stay ahead of all other countries with regard to the environment, to carry the ever-increasing environment-related costs, and at the same time remain competitive globally. "Economics and ecology must remain in balance," says Strenger.

All Production Steps

During question time Strenger explained that Bayer is committed to its environmental program, despite a decline in business in the chemical industry. Germany is still Bayer's preferred country for its investment and manufacturing activities. In foreign countries Bayer also applies the severe German standards: "Whether we are working on the other side of the world or right here, we always respect the environment."

After President Strenger, several members of the board of management discussed aspects of Bayer's environmental policy. Ernst-Heinrich Rohe presented good results with regard to the reduction of emissions in surface waters and the atmosphere. The discharge of chemical waste water has been reduced from 107 [metric] tons a day in 1986 to 61 tons a day in 1990. Bayer currently discharges 45 tons of organic waste a day in Leverkusen. This is only 2 percent of the total organic waste load in the Rhine at Leverkusen. Compared to 1981, waste water discharges of all Bayer factories in Germany have fallen by 63 percent, despite an increase in production. Discharge of heavy metals has been cut by more than 50 percent. Emissions of nitrogen oxides into the atmosphere have decreased from 14,100 tons a year in 1986 to 8,200 tons a year in 1990 (-42 percent).

Sulfur dioxide fell from 18,500 tons a year previously to 10,300 tons a year in 1990 (-44 percent). Sulfur emissions have been reduced by 43 percent and emissions of organic compounds by 50 percent. In 1990, the annual

solid waste output still amounted to 900,000 tons. This is not a substantial improvement in comparison with 1986, despite all the efforts.

Dieter Becher emphasized the favorable results of the integrated environmental approach, which consists in subjecting all steps in the production process to permanent scrutiny in order to see whether waste can be avoided or reused as raw material for other processes or for heat or energy production. The integrated environmental approach is a never-ending search for technical progress.

A Bitter Pill

One of the examples that Becher cited was the new production process for H-acid at the Brunsbüttel factory. H-acid, which has existed for 100 years, is a derivative of naphthalene. It used to be produced in Leverkusen involving enormous amounts of waste water and waste products. The integrated environmental approach led to a 20 percent reduction in the consumption of naphthalene, nitrous acid, and calcium carbonate. The new process reduces gypsum waste by 38 percent, waste water by 70 percent, iron oxide sludge by 100 percent, and sodium chloride by 100 percent. Chemical oxygen demand has been reduced by 96 percent and the sulfur dioxide is completely recycled. Only sodium sulfate in waste water rose by 12 percent—a minor imperfection.

However, the environmental improvements which have been achieved do not compensate for the extra costs. Standing by and watching India and China flood the market with cheaper H-acid because it was produced using the old, polluting methods, is making this an increasingly bitter pill to swallow for Bayer. This situation is definitely not speeding up the implementation of the integrated environmental approach, according to Becher. [passage omitted]

FACTORY AUTOMATION, ROBOTICS

EC Promotes Robotics Technology Standardization

92WS0074B Duesseldorf VDI NACHRICHTEN
in German 11 Oct 91 p 27

[Article by Rainer Hofmann: "Nationalism As Obstacle to Trade: EC Internal Market Requires Technological Unity; Standardization Facilitates Transnational Cooperation Between Manufacturer and User"]

[Text] Duesseldorf, VDI-N, 11 Oct 91—Standards are definitions of recognized technology rules. Especially in a coalescing Europe they are increasingly gaining importance, yet suppliers of technological products want to guarantee compatibility with other design elements. On the other hand, adherence to specific standards also, to a certain extent, guarantees quality.

Since the German system of standards is considered to be the most complete in the world, it is no wonder that the European system of standards that is at present being drafted for assembly, handling, and industrial robots (MHI) is influenced by our system. "Standardization contributes to industry's ability to compete on all markets with the creation of a technical domain common to all industrial and business activities." This is how Wilhelm Dey, the head of the Committee for Mechanical Engineering Standards (NAM) at the German Institute for Standardization (DIN), put it.

The drafting of European guidelines for machines, which may be regarded as a basis for an appropriate system of standards was an occasion for taking stock of the NAM's current activities, which are closely linked with those of the European Committee for Standardization (CEN), although the worldwide ISO [International Standards Organization] system of standards is accorded top priority here in Germany. The German capital goods industry just happens to be first among the industries with the largest export quotas. It is therefore no wonder that this industry in particular is trying to eliminate export barriers.

"The free market in Europe requires the dismantling of technical obstacles to trade," is how Dey sees it. Nevertheless, dismantling all trade barriers can be expected to cost DM163 billion, a sum that can be additionally managed in Europe. But national regulations in Europe are so different from one another that cooperation between supplier and user is impeded, as was established by the EC's Ceccini Report.

Especially in the domain of assembly, handling, and industrial robotics, European manufacturers have recognized the need for a system of standards that is obligatory for everyone and they have been trying to include the technical competence of all the member states of the EC, but also of EFTA in the standardization project since the early 1980's. Among other things, the item concerning the ability to check on compliance with standards and guidelines is open to question. According to the draft at present under consideration, a statement by the manufacturer that he has designed and built his machine in accordance with the safety requirements and guidelines is sufficient. "Some members of the European Commission are by no means happy with this liberal approach," Dey thought.

In any event, since the end of 1990, a standard has been under consideration which would provide definitions and characteristic features for 15 distinct sizes of industrial robots. In addition to these, special applied technology testing procedures from the technical fields of spot welding, track welding, and glue/surface technology are at the present time being elaborated. Furthermore, there are already several ISO standards that describe coordinate systems and movements of track-guided machines (ISO 9283, 9946, 9787, and 8373). The latter is especially interesting because it contains a comprehensive multilingual lexicon in an addendum.

Again and again, safety is an important topic as concerns robots. The European countries' different safety philosophies become especially evident in connection with this. While the French and the Spanish place more importance above all on warning systems, the German committee insists on a built-in safety system that in general always restricts the robot's freedom of movement and speed when service personnel are present in the operations area.

ISO 10218, of course, requires fail-safe measures, but does not specify them. Thus, while a pertinent VDI [Association of German Engineers] guideline refers to 25 cm/s as the maximal operating speed for a robot during necessary maintenance or programming operations within the robot's range of movement, the ISO, on the other hand, does not provide for any limit. The installation of assent switches ("dead-man's switches") which, in certain cases, are also provided with an "emergency-off function," is also contested in the appropriate study groups.

Work on a uniform, neutral electronic intersection point between programming and control of the robots appears to afford a simpler solution. Here too, the German standards carry a lot of weight since the DIN 66313, "Industrial Robot Data," served as the basis for the development of the ISO's ICR (Intermediate Code for Robots). This intersection point should enable manufacturers of robots and/or robot controls as well as users to adapt to different programming systems.

Prof. Christian Blume of the polytechnic in Cologne explained that rapid execution of programs and simple command semantics were important advantages. "The ICR is at present serving as a basis for the development of a uniform programming language, the Programming Language for Robots (PLR)." Not until May of this year did the members of the WG 4 (programming languages) Subcommittee of the CEN agree to tackle this development. Also quite new is the decision to make use of Version 2.5 of the German Industrial Robot Language (ILR) as a starting point.

As with the electronics, they also have to refer to certain intersection points with the mechanics involved, for example, when various tools are inserted in a robot arm. Dr. Jorg Niederstadt of the Mannesmann Rexroth Company, who is also chairman of the AA 5 Subcommittee of the NAM, reports that the round flange has achieved international recognition. Since 1989, ISO 9409, which has its origin in DIN 24601, has established the graduated-circle diameter and other important features of the robot hand.

Lately, a shaft flange has also been discussed in Japan and America, however, according to Niederstadt, so far only at an international level. Standards should not, after all, hinder development, rather to make manifest what has already been widely recognized, Niederstadt felt. This is why further developments are awaited in this domain.

There is still certainly a large backlog of work for the 45 CEN technical committees that are occupied with C standards, that is, with product standards alone. In the meantime, accomplishing everything by the end of 1992 seems to be more than doubtful. There are even bound to be experts who do not count on having a comprehensive set of regulations before the end of the century. Some committee members are evidently making a great effort to transfer national rules to Europe.

This article ends the VDI NACHRICHTEN "Mechanical Engineering State-of-the-Art Technology" series.

The following have appeared up to now:

"The Motor as a Focal Point of Investments," No. 36/91, p. 25. "Microwave Technology: Successful Race to Catch Up," No. 37/91, p. 36. "Globalization of Markets Requires New Manufacturing Strategies," No. 38/91, p. 28. "Suppliers Become Partners in Research and Development," No. 39/91, p. 34. "Environmental Protection Lets Industries Grow," No. 40/91, p. 32. "EC Internal Market Requires Technological Unity," No. 41/91, p. 25.

European Role in Third-Generation Robotics Development Discussed

92WS0110C Paris LES ECHOS in French
23 Oct 91 p 27

[Interview with Georges Giralt, advanced robotics specialist, by Jean Baudot, date and place not stated: "Mechatronics: France Gambles on the Robots of the Future"; first paragraph is LES ECHOS introduction]

[Text] Georges Giralt is director of the Robotics and Artificial Intelligence Group at LAAS (Systems Analysis and Automation Laboratory) in Toulouse. He will represent France in the advanced robotics group formed by the G7 at the end of the Versailles summit. He has just assumed the presidency of the RISP [Planetary Exploration Robot] laboratories consortium, which has been assigned the task of designing a robot to explore the planet Mars by the CNES (National Center for Space Studies).

[LES ECHOS] What is the international pecking order in the mechatronics industry?

[Giralt] Mechatronics is the advanced melding of mechanics and electronics, conceived of in a totally integrated fashion. It is no accident that the term was coined and imposed by the Japanese. Japan has in fact won the first round of battles in manufacturing robotics, and it is logical that Japan should be the one most concerned that robotics evolve toward greater autonomy and greater production-line flexibility.

Operating Inside the Human Body

To pursue its lead in field, Japan has just launched a huge miniaturization project christened "Large Skill

Project," that will bring together MITI laboratories and a group of manufacturers to work on minirobotics.

[LES ECHOS] Do France and Europe still have a role to play?

[Giralt] Certainly. One of the most promising topics in mechatronics are mini- and micromechanisms. I have already asked the government to support two long-term projects to miniaturize robots on the millimetric scale, for work inside pipes, for instance. It is even possible to imagine, in a much more distant future, mastering micron-scale robotics. This would allow, among other things, surgeries inside human bodies.

[LES ECHOS] Besides developments in this type of robotics, which is already traditional, what are the big issues at stake in the next decade?

[Giralt] The battle that has not yet been won, on the other hand, is smart machines, third-generation robotics: the generation of autonomous robots that are capable of reacting to different situations and environments. The application possibilities for this new generation are incredibly wide-ranging: agriculture, mining, surveillance and intervention in hostile territories, safety, oceanography, space exploration, etc. And in this race, France's position is not bad.

[LES ECHOS] In what fields of application are you working in particular?

[Giralt] Industrial and scientific interests now overlap sufficiently to have spawned projects that integrate the big problems of third-generation robotics: perception of surroundings, representation and application of knowledge, capabilities for programming machines to handle abstractions. These projects notably involve undersea robotics and civil-protection robots such as the AMR [expansion unknown]. They were designed by EUREKA program researchers, and their first prototype demonstrations will be held next year.

[LES ECHOS] What project is the most promising in terms of research and development?

[Giralt] Without a doubt, the VAP (automated planet vehicle) project, which was devised by the CNES and for which the RISP consortium was just created. The latter includes big laboratories of the CEA (Atomic Energy Commission), CNRS (National Center for Scientific Research), INRIA (National Institute of Research on Data Processing and Automation), and CERT-ONERA (National Office of Aerospace Research & Studies/Toulouse Research Center). The group should go international in 1992. Designing vehicles for planetary exploration will allow us to meet big challenges in advanced 21st century robotics regarding decision-making and operational autonomy and perception of surroundings.

German University Developing Robotic Inertial Navigation System

*92WS0148C Duesseldorf VDI NACHRICHTEN
in German 18 Oct 91 p. 26*

[Article by Rainer Hofmann: "‘Steel Hands’ Remain Reliably On Course"]

[Text]

Robots Position Themselves Using 3-D Coordinate Measurement

A Computer-Aided Inertial Navigation System Permits Exact Determination of Position

Modern production lines are inconceivable without industrial robots. However, there are still problems with the positioning accuracy of the end effector of a robot, that is, its hand. This dismays those involved in manufacturing automation. A research project at the University of Saarbrücken is now promising a remedy. There, the engineers are developing an inertial navigation system to determine, with high precision, the gripper coordinates within the operating range.

Prof. Hartmut Janocha works for the Chair for Process Automation (LPA) at the University of Saarbrücken. He describes the central problem like this, "The main difficulty is not in the repetitive accuracy of an industrial robot but rather in approaching arbitrary coordinates in three-dimensional space with sufficient accuracy." The repetitive accuracy of advanced handling systems is 0.1 mm. However, the absolute position in space can be full of errors exceeding that number by an order of magnitude, thus about a few millimeters!

The reasons for such inaccuracies come from the static or dynamic loads on the robot arm. Deformations of the support arms under load conditions and an elasticity in the joints and drives cause these deviations at the end effector of the robot. An electronic system determines the position of the end effector, the hand of the robot. This system uses a coordinate transformation with data from the angular sensors in the joints. Accumulating errors is unavoidable during this process.

Only a reference measurement using an externally fixed coordinate system promises a remedy. Industrial theodolite systems specify such reference coordinates. The Wild-Leitz company of Wetzlar, for example, has developed such a system. Appropriate corrections are then calculated from the differences between the reference coordinates and the robot data. "Measurement with such a system is very complex. For example, the greater the operating range of a robot, the greater the field of view the theodolites must have. In addition, the robot itself may obscure these fields of view." This is how Janocha briefly sketches the disadvantages of this method. The high price of up to 500,000 German marks also limits wide acceptance.

Janocha and his coworkers approached the problem in two ways. "The simple method works with a camera and special triangulation sensors we designed and built ourselves." In front of a graticule disk, the camera determines the position of the robot hand and compares it with the coordinates of the robot control system. The engineers at the LPA worked in close cooperation with a renowned robot manufacturer (Reis). They modified the control software of a 6-axis industrial robot so the correction data could be exchanged in real time.

As they cannot test many points because of time—"That would have taken weeks"—they developed an interpolation process. With a coarse triangulation point grid and a model of the error behavior of the robot, they improved the absolute positioning accuracy of the robot with a low expenditure for measurement.

However, the researchers in Saarbrücken aimed for an absolute measurement accuracy corresponding to the repetitive accuracy of 0.1 mm. Therefore, the engineers at the Saarbrücken institute are also working on a completely different, in physical terms, measuring system. The project leader, Dipl.-Ing. Edgar von Hinuber, says, "We are putting an absolute measuring inertial navigation system into the hand of the robot. In a similar form, such systems help navigate aircraft, submarines, or in geodesy." Expressed in simplified terms, this is a system with three rapidly spinning gyroscopes, each having an acceleration sensor.

Mounted on the end effector, this gyro system determines its precise orientation. Moving the gyroscopes from their position creates a measurable force. In turn, this force specifies the accelerations accompanying the change in orientation. Integrating the acceleration values twice allows determination of the distance traveled. With this data, the system can specify the position. The smallest accelerations measured are around $10 \mu\text{m/s}^2$. This value is 1 million times smaller than the acceleration due to gravity (about 10 m/s^2). This acceleration interferes with all measurements and must be eliminated. Incidentally, the effects of Coriolis force, caused by the rotation of the earth or vibrations of any kind, also interfere with the measurement and must be compensated.

This is precisely the problem. The value of the acceleration due to gravity changes on the one hand with the altitude above sea level and, on the other, with the geographic latitude of the location. "The German Geodetic Research Institute in Munich is calculating for us the value of the acceleration due to gravity down to five digits after the decimal point for every measurement location," explains von Hinuber.

On the other end, the largest useful accelerations occurring at the end of the robot arm itself are on the same order as the acceleration due to gravity. It is no wonder that the sensors having a measuring range of six orders of magnitude are not exactly cheap. They cost about 8,000

German marks each. The gyroscopes that must satisfy similarly high demands cost about 33,000 German marks each.

Such resolution also requires a highly developed analog/digital conversion system. Therefore, the engineers at the LPA also had to develop their own 20-bit A/D [analog/digital] board. In spite of this, estimates von Hinuber, the pure material costs of the entire inertial measurement system will be about 150,000 to 200,000 German marks. Thus, it would be significantly less than the optical systems.

Such absolute measuring systems are also useful for the programming of automatic handling equipment off-line. The programmer no longer has to teach the individual positions at the site. Simulation on a screen is satisfactory for him to calculate and to program the movements of the robot arm precisely.

It must only be guaranteed that the robot moves to the calculated positions precisely. Angular errors of 1/1000 degree of arc result in deviations of a few tens of centimeters. In addition, there are no restrictions of any kind on the operating range. This is because the measurements are independent of any spatial restrictions on the assembly line, contrasted with the conditions for optical measuring systems.

Of course, the number of measured points cannot be very large here. However, trials have shown that a triangulation point grid of between 5 and 10 cm with a measuring time of 5 s per point is adequate for the required absolute precision of 0.1 mm, according to von Hinuber. That would be dependent on the type of robot, the number of axes of the operating range and other aspects. Only symptoms of wear, for example in the joints and drives, make recalibration necessary in regular intervals.

Von Hinuber sees an additional application, particularly for mobile robots. Without such a measuring system, these robots are always reliant on a remote control system. Mobile robots would then be completely autonomous and independent of, for example, induction loops or similar auxiliary systems. Then, a navigation system coupling an inertial system with image processing would be conceivable.

Germany: AutoCAD 11, DynaCADD, WINCAD Systems Described

AutoCAD 11

*92WS0130B Berlin MIKROPROZESSORTECHNIK
in German Oct 91 pp 15-16*

[Article by Peter Sellg, Berlin: "AutoCAD 11"]

[Text] In order that you may form a more precise picture of the capabilities of individual CAD programs, we have selected three systems for PCs, in which each represents a group of programs. We begin with AutoCAD 11, which

is counted as a powerful and, of course, higher-priced program. Two CAD systems from the low-cost area follow—DynaCADD, which can run equally on the AT, Atari, Amiga and Mac, and WINCAD, which is one of the first CAD programs for Microsoft's Windows 3.0.

Bad Habit or Market Strategy?

This question is being asked more and more frequently, since many software manufacturers announce their new programs with imminent arrival dates. But a great deal of time often elapses before the customer can call the new product his own. Now, however, AutoDESK has done it—its new AutoCAD Version 11, the widespread professional CAD program, is available and offers considerable features.

The state of network support now achieved is quite remarkable (network operation was possible before as well, of course). Version 11 permits unique allocation for each user in the network. The login name is determined during installation.

Systems maintenance is considerably facilitated by means of network operation. Several AutoCAD users in one company can access a joint, uniform, library and design pool.

It is now also possible to integrate external reference designs in an active design, without these being fixed components. Thus, for centrally managed design sections the most recent standard is always incorporated. Furthermore, unnecessary redundancy in the data base is avoided and storage space saved.

When a design file is being worked on by a user it is blocked to all others (file locking). This prevents the destruction of hours of work when another user is merely down-loading.

Programming Now in C as Well

The new AutoCAD Development System, abbreviated ADS, now enables the application programmer, in addition to the Auto LISP interface, to use the programming language C as well and thus to utilize many already existing modules. The new data types and commands are also made available to the LISP programmer, of course.

Particularly notable is the possibility of operating the work monitor in two modes, one in the model field (corresponds with the familiar one), in which the actual design is being created, and the other in the so-called paper field. Here, up to 16 windows, which contain only certain parts, views or cuts of the overall design, can be mixed and printed out in the desired paper format with plotters and printers.

By means of the considerably improved dimensioning tools which are easily reached through dialog boxes, the designer now has the ability to determine various line widths and colors for measurement lines, auxiliary lines,

dimension text and the structure of the dimension. Standards such as DIN, ISO and ANSI can thus not [sic] be realized.

Commands With Umlaut Characters

The comfortable operator guidance by means of dialog boxes was expanded. Now, design files, character sets, shading patterns and other things can be selected from a list on the monitor. This makes AutoCAD 11 considerably more convenient. This is also shown in handling text for the design. All character sets were converted from 7 bits to 8 bits, so that all umlaut signs are now available. This creates problems as well, however, because instead of umlaut descriptions the commands now contain the umlaut signs themselves. Users of earlier AutoCAD versions will have to adjust to the new notation. Another consequence: All AutoCAD applications had to be rewritten for Version 11 and in part are still being worked on.

Error Correction and 3D

If data errors occurred in a design file with earlier AutoCAD versions, you could forget the design. This is not something the AutoCAD 11 user has to worry about. The file header is stored twice in the design file, and all tables of blocks, text styles, line types, views, coordinate systems, view windows, dimensioning definitions, registered applications and design elements get their own checksums. When errors occur, AutoCAD tries to correct them. If that does not succeed, because too much information is missing, the error-containing block is skipped. All other paragraphs are read in, however.

The 3D capabilities of AutoCAD have been expanded even without the AME option. Three-dimensional primitives such as right parallelepipeds, cylinders and spheres are offered by way of a menu window. More complex 3D images are produced from a fishnet design with connecting extrusion or rotation. For further processing, including logical connections of 3D objects, it is necessary to have the Advanced Modelling Extension (AME). Complex objects are created by combination, differentiation or formation of the intersection of independent objects. By allocating specific material properties from a data base, physical values such as volume, weight, center of mass coordinates, principal axes of inertia, inertial radii, radii of gyration and surfaces are calculated.

Simple shading can be carried out without the additional AutoSHADE program with the Quick-Shade integrated into Version 11. This provides help in visualizing 3D objects, in particular.

All of these new possibilities naturally pose major demands on the hardware. For this reason AutoCAD 11 runs on 386 systems with math coprocessors and up. Anyone who still wants to work with AutoCAD on a 286 will be able to use the still available Version 10.

The basic German version of AutoCAD 11 costs exactly as much as its predecessors: DM11,300 (all prices

excluding sales tax). With the Advanced Modelling Extension, the price increases to DM12,300, and AME alone can be had for DM2,050. For an update of AutoCAD 10 to 11, you only need peel off DM750 for the basic version (without 3D models) and DM2,050 with AME.

The New Highlights of AutoCAD 11.

Network Support through, among other things, file blocking, which prevents several users from working on a file at the same time and thus losing data;

AutoCAD Development System (ADS) in addition to AutoLISP now also D-interface for programming expansions and applications;

Multiple Views up to 16 view windows (projections and cutaway views) can be arranged on one screen or plot;

Expanded Dimensioning, for example, different line thicknesses for measurement and auxiliary lines as well as dimensional descriptions (according to DIN);

Text Cell Editor in the form of a dialog box, support for the German umlauts by an 8-bit character set;

Expanded Dialog Boxes such as for selecting symbol files, slides, hatch models, etc.;

External References linking reference designs with an active design;

Expanded Object Data (EED) supplies "attributes" for each design element and makes later evaluation possible;

Alias Command Names are now possible;

Data Security design file error monitoring enables regeneration of data losses;

Solid-State Primitives such as wedges, spheres, cones, right parallelepipeds, cylinders, etc. are included as a standard feature;

AutoCAD Advanced Modelling Extension (AME) optional solid-state modelling including volume, mass and center of gravity calculation with various material properties;

Integrated Quickshade as an aid to visualizing included as a standard feature;

Full Utilization of the 386 Features.

DynaCADD

92WS0130A Berlin MIKROPROZESSORTECHNIK
in German Oct 91 pp 16-17

[Article by Dr. Bernd Schulz, Berlin: "DynaCADD; CAD Software Under GEM 3]

[Text] DynaCADD was developed by DITEK International and presented at CeBIT '91 by Cybernetical Research & Production (CRP) as a "professional CAD

program for 2D and 3D applications." At least one professional user interface is provided by the Graphics Environment Manager (GEM) Version 3 by the Digital Research company when using an IBM-compatible PC or an Atari-ST or TT. The ability to run on the Amiga and the Macintosh is also assured by the supplier. The system-spanning features, combined with the low purchase price of about DM3,000, are another reason why you should take a closer look at DynaCADD. We selected the PC version for this.

A Few Words About Hardware and Installation

In order to use DynaCADD with MS-DOS, it is only necessary to have an 80286, but an 80386 or 80486 system is better, of course, and at least 1 Mbyte expanded memory (EMS 3.2 or 4.0). With the 286 system the expanded memory must be hardware-supported. With 386 or 486 systems, the Expanded Memory Management, offered by QEMM (Quarterdeck Office Systems) and 386MAX (by Qualitas), among others, may be used. You should reserve at least 2.2 Mbytes on your hard disk for a DynaCADD installation. (DynaCADD is delivered on two 1.2 Mbyte or 1.44 Mbyte diskettes with an approximately 600-page user handbook.) The overview provided in the handbook of the graphics cards supported by DynaCADD—only Hercules, EGA and VGA are listed—must make the potential user somewhat puzzled, however. Only during installation does he get the advice that graphics cards with the high resolutions common in the CAD field, such as 1280 x 1024 pixels, can also be used, but only on the conditions that a corresponding driver for GEM 3 was included in the package delivered by the card manufacturer. However, since a trend in the direction toward MS Windows can be seen, this is to be expected in only a few cases. Similarly, the recommendation of CRP digitizers as the only potential pointing device also appears somewhat strange, since in the installation menu the use of a mouse and other tablets are offered. On the other hand, the PC-CAD systems from market leaders—such as AutoCAD by Autodesk and CADdy by Ziegler-Instruments—offer the user considerably more freedom of action with respect to graphics cards and pointing devices that can be installed.

The installation of DynaCADD is—also thanks to the good description in the handbook—without problems. It should only be noted that even a 768 Kbyte EMS is sufficient to make the CAD software come to life.

System Operation

The first steps are made easy for the user by the extensive examples from the 2D and 3D areas given in the handbook. The GEM-3 user interface assures comfortable work with its file windows, dialog boxes, pull-down menus and icons. Since actions are essentially triggered with the icon symbols, a higher screen resolution than the one offered by standard VGA is recommended. As long as no extensive symbol libraries are being used, the

user can do without a tablet. For professional applications, however, symbol libraries (standard parts of mechanical construction, electronic components in board construction) are unavoidable. Splitting up the multitude of functions of a CAD system over the various GEM 3 screen menus can be described as successful (see Fig. 1 [not included]).

The pull-down menus are for

- working with files
- establishing design parameters (rasters, line type and color, hatch pattern)
- controlling of global switches
- handling coordinate systems and views.

Directly above the character level lie the icons for design representation. The actual design functions are activated through four icon menus.

Only when choosing a basic function (integrating elements, manipulating elements, using layers, design output), does movement occur in the icon menus, which have been empty until then. Specifications for calling up commands are thus offered as a function of the text. Nevertheless, working with DynaCADD requires getting used to it, because it is not always recognizable from the screen representation, what coordinate input is expected in each case. But here one is helped by the online documentation, which explains the current command in detail.

Range of Functions

DynaCADD supports the 2D and 3D edge model as a computer-internal geometry model. The geometric elements needed to make the design such as a circle, circular arc, straight line and polygons are supported in two- and three-dimensional modes. These standard elements are supplemented by Bezier and B-spline curves and express possibilities for introducing texts, in which a font editor permits creation of special fonts.

The formation of groups (blocks) and the use of design layers (layers) can also be used as CAD specific working methods. Symbol libraries with standards from various application areas can be had from the supplier.

Adjustable coordinate grids and grid lines are intended to make the design work easier. But the coordinate grid in particular is a source of surprise, since it is not until the pick button of the pointing device is activated that it jumps to the next grid point.

The state-of-technology manipulation functions are supported by a large number of possibilities for choosing objects. The dimensioning of 2D and 3D objects takes place according to DIN. Parameters such as arranging the dimensional descriptions, tolerance indication and precision in dimensioning are clearly displayed in a dialog box and can be altered there. In addition to

horizontal, vertical and angle dimensioning, base lines and chain dimensioning are offered. The automatic insertion of dimensional descriptions is not satisfactory, since overlapping can occur which makes follow-up work necessary. Tracking of the dimensioning when changing object size—common with CAD systems from the market leader mentioned above—(associative dimensioning) is also not done.

For 3D construction DynaCADD offers freely definable coordinate systems and a maximum of four view windows. But it does not seem very sensible to me to use this considerable expense to make a 3D edge model, since the spatial views are not very graphic.

Control of the design output on 9 or 24-pin printers as well as postscript-capable printers is done in a dialog box and is very flexible because of the adjustability of the interface parameters. In addition to the CAD program, the software package offers a GEM application for generating your own plotter drivers. These can thus be used alongside the drivers for standard plotter formats such as HPGL, Houston or Calcomp.

Interfaces

The interfaces to other CAD systems and the components which are included in the CIM concept, in particular CAP, CAM and CAQ, today form the key touchstones for the acceptance of CAD software. Here, DynaCADD only offers the opportunity of exchanging files with other CAD systems over the DXF format, or, respectively, a DynaCADD-specific ASCII format. Importing a 3D design over the DXF format delivers only 2D elements, whereby the majority of the initial elements dissolved into nothing. No references to program language-oriented interfaces can be found in the documentation. Additional features which characterize a professional CAD system, such as connection points for design management, parts list generation or variant construction are not available.

Summary

DynaCADD delivers well developed functions when generating 2D designs and presents itself in a user-friendly manner with the GEM-3 interface. Operation becomes somewhat nerve-racking when not enough EMS was made available. Here 1 Mbyte is really the bottom limit. The lack of flexibility with respect to the applicable graphics cards and pointing devices, as well as the lack of interface functions, are not compensated for by the comparatively low price of DM2,990 for the full version. For that reason DynaCADD at its present development stage is only recommended as CAD software for beginners and for training purposes, although the price is really too high for that. The rating of "professional" cannot be awarded.

WINCAD

92WS0130A Berlin MIKROPROZESSORTECHNIK
in German Oct 91 pp 17-19

[Article by Dr. Eberhard Stens, Berlin: "WINCAD; a CAD Program for Windows"]

[Text] WINCAD—a product of the Tommy-Software company in Berlin—presents itself under the user interface Windows as a universal CAD program and thus offers the advantages of the Windows interface—connected with the usual CAD functions.

Basics

The prerequisite for running WINCAD is MS-Windows (in the program available to us as Windows Version 3.0), whereby the minimal hardware prerequisites are fixed. In an actual case WINCAD would be installed in a 386 AT with 2 Mbytes working memory. The program takes up about 1.5 Mbytes on the hard disk.

In order to create professional designs, a corresponding graphics adapter should be used because of the required resolution. For high-resolution graphics (1280 x 1024 pixels) there are no data at all. VGA is supported without any problems. In order to keep the calculation times reasonably short a math coprocessor is recommended, but WINCAD also runs without a coprocessor. WINCAD is essentially offered in the three hardware variants WINCAD-Starter, -Standard and -Plus at the comparatively low price of DM998, 1,498 and 1,998 (including sales tax). Starter and Standard have a limited number of functions compared to WINCAD-Plus, whereby the menu structure was retained.

WINCAD-Plus is delivered on three 1.2 Mbyte diskettes, together with a short manual and a handbook of about 400 pages.

Input Possibilities

In order to select commands, three possibilities are basically offered:

- with the main menu (pull-down menu)
- with the pop-up menu
- with the keyboard

The function keys as well as a few additional keys are permanently reserved for certain commands. In addition, the possibility exists of allocating commands to the number and letter keys according to choice. The mouse, the principal input tool, moves a cursor, which appears as crosshairs when designing, as an arrow when selecting commands and as an hourglass when executing calculations.

Screen Division

The monitor screen is split into several working areas in the basic display after starting up the program. The

largest field is occupied by the design surface, which is limited on the right and lower sides by icon bars. In the title bar at the upper edge of the monitor screen the correct design file is indicated along with the program name. The second screen cell is occupied by the menu bar, which enables access to the principal function fields of WINCAD.

Between the menu list and the design surface is the status window, consisting of three lines. This is where current program parameters are displayed or altered. To make changes, the corresponding field must be clicked on, after which the desired parameter can be modified in the dialog box that appears.

The first line indicates the current command and the kind of point to be entered next. The second line serves to indicate and modify the current layers, the line status (width, color, pattern), the character parameters (mode) and additional status information (such as the raster, grid, selection type, blocking of the X or Y direction.)

The third line shows the coordinates and the relative shifts from the point last entered with x and y shift, length and angle. Clicking on a dimensioning unit activates the unit-dialog box. Creation of the design is comfortably supported by a status window.

The pop-up menu appears in the plotting area after activating the right-hand mouse button or key F9. It consists of five superimposed layers of 25 icons each. An icon is a graphic symbol which has a certain command allocated to it. In order to select the desired layer, one simply moves the cursor over the corresponding surface selection field. If the cursor is subsequently placed over an icon, it appears inverted, whereby simultaneously the appropriate function is displayed in the status window. The pop-up menu can be supplied with functions by the user according to need.

Range of Functions

In order to create designs, WINCAD supports all common 2D geometry elements including conic sections, polyhedrons, zig-zag lines, arc chains, Bezier and spline curves. The opportunity further exists of setting up and utilizing libraries, as well as text input and processing. The currently common manipulation commands are supported with extensive possibilities for object selection and construction aids. Operation is somewhat cumbersome in part, since various functions from different menus are needed for certain constructions or manipulations. Such simple or necessary means of identification as the end point, midpoint and center of a circle, etc. seem not to be necessary for creating designs with WINCAD or remain hidden to the user. The documentation is also of no help here.

Essential to practical work is to acquire a group technique (combination of objects and their manipulation) and a layer technique, which are well supported with WINCAD. Dimensioning takes place according to DIN.

The dimensioning parameters are clearly displayed in a dialog box and can be altered as desired.

The user has access to the principal menus of file, manipulation, view, object, drawing, special, symbol, select, technical, design and help by means of the menu strip mentioned above. Due to the multitude of functions offered by WINCAD, only a selection can be discussed.

The functions for dealing with complete files are made available by the File menu. In order to utilize foreign design formats, the functions for import and export of designs are offered. A test of these functions could not be undertaken here because the program was missing. But the interface problem is particularly important for integrated application of CA techniques (such as NC coupling). The attempted import of a file in DXF format resulted in a great deal of flickering on the screen and total failure. Continuing with the work was only possible after restarting the computer.

The Manipulation menu contains functions for manipulating (modifying) designs or design elements, such as UNDO (reversing the last 100 operations), REDO (reversing the last UNDO operation), erasing, copying, linking, etc. Further, this is where menu items for changing the key allocation and the pop-up menu are located. Of special interest for design organization is the possibility of displaying and updating information on the design (title, subject, author, production date, modification messages, etc.) as well as search paths on diskette or hard disk.

The display and modification of the design parameters, the layer status, the dimensioning units, the sheet formats and the generation of various zoom functions, take place in the View menu. The functions to generate design objects are located in the Drawing menu, and the associated manipulation command in the Object menu. The commands to use and manipulate libraries as well as text acquisition reside in the Symbol menu. In order to select one or more objects for subsequent manipulation, various types of selection are offered in the Select menu. In so doing, some questions remained open, for example about the difference between principal and secondary selection. Dimensioning functions, for hatching as well as trimming (follow-up manipulation of objects) can be reached through the Technical menu. Additional functions, such as generation or manipulation of free-hand lines and free-form surfaces are included in the Design menu.

Program Documentation

In principle it should be welcomed that the documentation has been split into the two parts of short manual and handbook, since even advanced users more or less frequently need a reference book without always having to be sidetracked by basic explanations. The short manual should not remain stuck in general descriptions as an entry or training handbook, however, but lead through individual lessons as accurately as possible—supported

by examples. Basically, in documenting graphic program systems the possibility of explaining functions with images ought to be better utilized. The pictures should also be carefully numbered and supplied with titles describing the content. Pictures of the screen should show what the user gets to see on his own monitor during operation. A clear structure and a reliably compiled list of key words, as well as a handy and easily understood reference map are also important.

The fact that these demands are not immediately realized to the full extent in new software products is partly understandable, but they should quickly be implemented in the course of a revision.

Summary

Despite some points worthy of criticism, WINCAD gives a positive impression. This applies to the range of functions offered and the resulting capability, as well as to the very fast reaction times of the system and the clear organization of the user interfaces. It is further noted as a positive fact that WINCAD offers various possibilities for user-oriented design of the system, which is comfortably handled through clear dialog boxes. The extent to which WINCAD is not only usable for design generation but also as a CAD system in the actual sense depends on the offering of expansion modules and libraries. A small overview of this is provided on p 18 [following this text].

The overall impression and the favorable price give it legitimate chances in the tough software market.

WINCAD News

The WINCAD object and image file formats can be purchased under the name WINCAD Toolkit 1 at a nominal charge of DM199 (including sales tax). This is particularly interesting for the application of WINCAD in integrated manufacturing systems (CIM), such as for control of computer numerical control machines and cutting plotters.

For industrial use, some libraries are already available and others are being set up or are being prepared. According to information from the manufacturer, libraries Nos 1, 2 and 3 are in the field of electrical engineering; No 4 for digital information processing is under preparation; Nos 5 and 6 deal with chemical engineering. The plumbing No 7, heating/cooling No 8 and ventilation No 9 are being compiled at present. Users from the chemical industry have three libraries for laboratory equipment available (Nos 10, 11 and 12). Additional libraries deal with the following areas: Transportation (No 13), interior decoration (Nos 14, 15 and 16), hydraulics and pneumatics (No 17), environmental technology (No 18) and landscaping (No 19). Each library may be purchased for DM249 (including sales tax).

IWT Forum at CAT '91

"Opponents" from the industry participated in informative and sometimes heated discussions at CAT '91 during a podium discussion arranged by IWT publishing company. The objective of the debates was to find out from competent experts where the focal points in the CAD field will be in the coming years.

Is MS-DOS at an end? Will another operating system dominate the CAD field? On this issue all participants unanimously agreed that the decision for the operating system will be made by the applications. And the view "that in the future operating systems will exist side by side" (Dieter Hoefler/Autodesk Deutschland GmbH) was shared by the users. Naturally, a better future for one or another operating system was predicted, depending on the "origin" of the debater. Thus, Gert Haas, marketing director of Sun Microsystems GmbH, emphatically represented the opinion that the CAD field is too demanding to be able to do justice to the MS-DOS operating system.

Unlimited processor technology? From the 486 to the 986—are Intel processors at a dead-end street?

Rolf Oestringer, application engineer at Intel GmbH, understandably denied this question. On the contrary, based on an internal study he predicted a technological jump, which would make it possible for Intel to "offer performance by the end of the decade permitting the execution of up to two billion instructions a second."

Together with his "opponent" Axel Hartstang, marketing director of Motorola GmbH, he was of the opinion, however, that the times of a "general processor, which can be used and deployed everywhere, are past." For that reason, according to Axel Hartstang, Motorola is building special, extremely powerful products in order to be able to offer a suitable component for every philosophy.

LAN Vision 2000—to which network does the future belong? Topology competition in the computer application field?

Axel Schulze, chairman of the board of Asonic Computer Equipment GmbH, dared to go out on a limb with his prognosis: "FDDI [Fiber-Distributed Data Interface] will come as surely as the amen in church." In his opinion, FDDI is the "topology of the future." But to him, as well as to Hansjoerg Schoenwaelder, Intergraph GmbH, the solution for the intermediate future is Ethernet or Token-Ring and FDDI as Back Bone.

Not without interest in the network area are apparently the cabling problems, as was shown toward the end by the very lively discussion. In this respect the focal point of the discussion was primarily the question of the effects of developing a standard such as the Office Wire Standard.

More detailed information on this and the next forum may be had from IWT Verlag GmbH.

MICROELECTRONICS

Future of JESSI Program Called Controversial

92P60095 Duesseldorf WIRTSCHAFTSWOCHE
in German 3 Jan 92 pp 86-87

[Text] Europe's microelectronics industry is in a crisis, and Siemens spokesman Klaus H. Knapp has already identified the guilty party: "The villain is the EC," says Knapp. In October 1991, at the instigation of Brussels, Europe's research authorities cut the subsidies by 350 million German marks (DM). As a result, many research projects are now in abeyance.

But to lay the guilt at Brussels' doorstep is to blame the wrong party. After all, the EC is cutting funds only because the initiators of JESSI themselves no longer really believe in the success of this billion mark project.

It is precisely the most important research companies which have long since departed from JESSI. The big three semiconductor manufacturers—Philips, Siemens, and SGS-Thomson—who were for a long time the main instigators and beneficiaries of the program, are now increasingly searching for their own ways out of the red ink of their chip departments. But JESSI was to achieve the exact opposite, that is, to unite Europe's industrial forces. The silent turning away from JESSI by the big companies is proven by a recently published letter from Siemens' board chairman Karlheinz Kaske to the EC Commissioner for Research, Filippo Maria Pandolfi.

Together with the Siemens' official responsible for semiconductors and also JESSI vice chairman, Juergen Knorr, the Siemens boss urged that future support for microelectronics in Europe should be directed more toward supporting production rather than research. "There is sufficient basic knowledge in Europe," writes Kaske, "the problem is converting it into practical use." To put it plainly: Kaske is asking for large EC subsidies for the expensive chip factory which Siemens is currently building together with IBM in Corbeil-Essonnes in France. Even the announcement in early 1990 of cooperation with the American computer giant was interpreted by observers as a "turning away from JESSI."

And yet the German/American team can demonstrate precisely the success which the JESSI project has been seeking in vain to this day. A few days before Christmas, the partners presented the first laboratory samples of a 64 megabit chip, not much later than the Japanese competition.

Public research institutes, such as the German Fraunhofer Society to Promote Applied Research (FhG), question more and more the point of European subsidies and their bureaucracy. FhG President Max Syrbe: "The degree of effectiveness of the JESSI funds is poor."

Research manager Syrbe interprets Kaske's call for subsidies for his own chip factory simply as a threat to further state support of research. The head of more than

2000 Fraunhofer researchers in Germany says, "Simultaneous support of research and manufacturing is politically impossible." The Fraunhofer head also says, "For us researchers, such a demand is simply counterproductive." Indeed Siemens is not the first deserter from the JESSI community. A year ago, Philips abruptly withdrew from the technology of static memory chips, thus ending an entire JESSI subproject. Now Philips is doing research, together with the Italian/French concern SGS-Thomson Microelectronics, in the technology of logic chips.

Shortly before Christmas, JESSI received the next blow. The Federal Association of German Industry (BDI), together with the FRG government and the computer industry, is planning a microelectronic "round table." BDI head Heinrich Weiss: "The first meeting may be early in the new year." FRG Minister of Research Heinz Riesenhuber has shown great interest, so that the round table could be expanded to a European initiative, according to Weiss. But then the round table of Weiss would be in direct competition with the European microelectronic program of JESSI.

JESSI, which was founded two years ago at the instigation of the European computer industry, has already cost about DM970 million. Industry itself has paid about half of the money, the national governments have contributed about 40 percent, and the EC ten percent.

It seems doubtful whether that is enough. A study by the French Thomson group which was published a few days ago says that the EC is subsidizing agriculture with about 30 billion dollars per year. In comparison, EC support of microelectronics is "tiny." According to the Thomson study, "the European manufacturers of semiconductors will disappear by the year 2000 due to inability to compete" without massive additional research subsidies.

Currently JESSI is being reoriented toward specific application research. The main fields of future research work will be high definition television (HDTV), digital radio, broadband ISDN, mobile radio, and automobile electronics.

If up to now European industry has considered joint chip research to be nonessential, JESSI in its current form is automatically superfluous. However, then the government research subsidies would disappear—about DM400 million for 1992 alone. For this reason, no one wants to talk publicly about withdrawing. JESSI still serves, according to a Philips employee, as "an excellent source" for EC subsidies.

International Firms Develop Multi-Use RISC Processors

92WS0174 Paris ELECTRONIQUE LE MENSUEL
DES INGENIEURS in French No 12, Nov 91 pp 11, 12

[Article by Francoise Grosvalet: "A 'RISC' [Reduced Instruction Set Computer] For All Applications"—first

paragraph is ELECTRONIQUE LE MENSUEL DES INGENIEURS introduction]

[Text] From the high-end PC to the sophisticated server, workstations, and dedicated control, there is practically a RISC for every application.

Users can now choose among the five 64-bit RISC microprocessors of IDT, LSI Logic, NEC [Nippon Electric Company], Performance Semiconductor and Siemens, and all the variants that should eventually be introduced. Not to mention the Performance 32-bit RISC microcontroller with a built-in floating-point arithmetic unit, and the 32-bit microprocessor with PA-RISC architecture marketed by Hitachi under an HP [Hewlett-Packard] license. Users can now find the RISC microprocessor best suited to their application, whether purely for data processing or in the industrial world.

A Module to Simplify Design at 50 MHz

The five manufacturers of the R4000 microprocessor, initially designed by Mips [sic], have actually announced their firm intention to develop versions derived from this processor, which appears to be the most powerful for the time being. Thus, Performance is planning to develop a multichip module that will make the designer's task easier. Actually, systems design, with processors like the R4000 that run at 50 MHz and over, is becoming increasingly complex. By offering designers a module that already includes all sensitive parts—memories and computing circuits in particular—Performance does some of the work for them and leaves to them the design of the low-frequency parts, which are far easier to master.

As for the Hitachi RISC microprocessor, referenced HD69010, it has built-in bit-level field-handling instructions, so that it should be easier to use in graphics display controller or office automation applications. The HD69010 can also be used in color photocopiers, robots, measuring equipment, X terminals, and many other systems. With a 16-MHz external clock, it can execute arithmetic instructions at a peak speed of 16 million instructions per second (Mips) with an average speed of 10 Mips. The HD69010 can operate with economic dynamic RAM's [Random Access Memory], which is not necessarily the case of the other RISC microprocessors on the market, in particular the R4000.

With its Piper, which combines on a single chip a 32-bit R3000-type RISC central processor, a floating-point arithmetic unit, and 10 kilobytes [8-bit bytes] of user-configurable cache memory (4 kilobytes each for instructions and data, or 8 kilobytes for instructions and 2 kilobytes for data), Performance Semiconductor is targeting the same market, that of dedicated control. In addition, this microcontroller has a built-in clock distribution circuit and delay lines, so that it will work with a single clock instead of two and will therefore be easier to install into the system. It also includes read and write buffers and the bus interface control circuits, which eliminates most high-frequency interference signals on

the outer pins and, again, makes it easier to install it and to design systems around it. Actually, no additional support circuit is required.

From the Simple PC to the Complex Multitasking System

As far as the R4000 is concerned, which was already amply described in our magazine (see in particular our article in the Trends section), the five semiconductor manufacturers each emphasize the possibility of differentiating their approach from that of their competitors, by developing either standard dedicated version, or application-specific versions.

For instance, NEC is planning to market not just the R4000, but also boards and modules with built-in second-level cache memory.

Siemens is following a very similar approach while insisting that today's dedicated control applications do not require the 64 bits of the R4000, whereas these 64 bits may prove necessary if one wants to network several tens of PC's. Actually, the key advantage of 64-bit processing is that it becomes possible to simplify the system's ability to process large volumes of data.

For its part, LSI Logic is considering developing, as it already did for the R3000, a set of circuits that would make it easier to design complete systems.

The R4000 is available in three basic versions: one, the R4000PC, with a primary cache memory, for PC's, small low-end servers, and dedicated-control applications. Another, the R4000SC, with secondary cache memory for single-processor applications, is designed for high-end PC's and servers. The third one, the R4000MC, is resolutely geared to multiprocessor applications.

Siemens Introduces New SMD Circuit Assembly Device

92WS0133B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 15 Oct 91 p 8

["Placing 39,000 Components per Hour"]

[Text] Frankfurt, 14 October—In Productronica, Siemens AG, Munich/Berlin, wants to show a complete production line using a surface mounting device (SMD) of electronics components. The most important innovation is the SMD-automatic insertion machine Siplace 80S. Thanks to its modular construction, it permits a broad spectrum of 80-, 160-, or 240-track configurations. Siplace 80S can process 13,000, 26,000, and even 39,000 components an hour. It can be coupled with the Siemens HS-180 and SP-120 automatic machines without difficulty.

Another product emphasized by Siemens is a line for winding auto relay coils with the individual parts being fed in automatically. By means of its new devices, Siemens hopes—at the lower end of the scale—primarily

to ease itself into the printed circuit insertion field with SMD-components, as well as improve the insertion performance and flexibility at the upper end of the scale.

Siemens considers various MS-72/MS-90 applications to be an inexpensive way of entering the field. These automatic machines are in the low-price class of such devices, which with closed control circuits consistently achieve a high degree of mounting accuracy for axial positioning. The MS-102/132 automatic insertion machines offer greater flexibility in the medium performance range. They have been designed for a variety of components and boards: printed circuits up to 460 by 460 mm as well as 102 and/or 132 belts in 8-mm format can be processed.

The domains of the HS-180 automatic insertion machines are complex mixtures of highly polished elements like flatpacks-, MCR-, and TAB-components and large PLCC. Components for the additional preparation of components should make it possible to process a very large components spectrum without a lengthy change-over time. The placing and soldering of Tab fine-pitch components with a pin pitch up to 0.4 mm can be carried out with the new Siplace ABG-400 automatic smoothing-soldering machine. Siemens has developed the Siplace LC automatic insertion machine for users who process wired components. Siplace LC can be used for radial and axial components, for DIPs and exotics with two or more connecting wires. Also new at Siemens is the HWS1000 table automatic winder, which has two spindles, a rotary table, and an adjustable wire regulator. The spindles move in three axes.

Siemens Photoresist System Aiming at 0.1-Micron Pattern Geometry

92WS0141B Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 17 Oct 91 p 8

[Unattributed article: "Down to 0.1-Micron Structures With 'CARL'? Siemens: 0.3 Microns Already Attainable With Two-Layer Resist System"]

[Text] Frankfurt, 16 Oct—A photoresist system developed in the central research laboratories of Siemens AG of Munich/Berlin enables photooptic production of integrated electronic circuit structures finer than 0.3 microns. According to Siemens, it is a two-layer resist system in which, in contrast to standard techniques, only a very thin, uniform layer must be exposed. The trick consists in transferring the pattern afterwards into a second underlying resist layer using anisotropic dry etching.

This significantly thicker resist layer provides the best possible exposure conditions for the thin resist layer. Reportedly, at the same time it also presents an adequately stable mask for subsequent etching processes. To achieve the etch resistance, the thin lacquer is chemically treated afterwards in a simple manner.

This process reportedly permits a controlled expansion of the optically transferred structure and thus a controllable reduction of the free spaces in between, which are exposed to the etching compound. According to information from the company, with this "chemical expansion of resist lines," abbreviated to CARL, contact holes and insulating ditches with 0.15-micron structures have been successfully produced, although the photooptical resolution of the exposure device was only 0.4 microns.

In the Perlach research lab, successful control for fine 0.30-micron structures on silicon wafers has reportedly already been demonstrated with the CARL lithography process. And here and there 0.25-micron structure widths have even been obtained. Siemens anticipates that in connection with improved high-aperture KrF [krypton fluoride] laser exposure devices currently in development, the CARL technique will be further adjustable for 0.25-micron technology.

Based on the absorption characteristics, modification of the resist system for future ArF [argon fluoride] laser exposure devices with a wavelength of 193 nanometers would seem to be possible. With that, a resolution of less than 0.20 microns would be obtainable. With an appropriate change in the phase position of the light in the mask layers and in the lens system of the exposure devices, use of photooptical processes even down to a structure width of 0.1 micron does not seem impossible; such structure widths would fit the dimensions on gigabit chips.

Thin-Film Technology Said to be Under-Utilized Internationally

Technology Off to Slow Start, but High Growth Rates Expected

92WS0157A Duesseldorf VDI NACHRICHTEN
in German 01 Nov 91 p 23

[Article by Harald Mehlich: "Thin Films Off to Slow Start: Key Technology Promises High Growth Rates"; first three paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 1 Nov (VDI-N)—High entry costs and the variety of processes scare off potential users.

Thin-film technology is on the threshold of mass production. However, many sectors are still uncertain because of the variety of information in this area. But there are initiatives which will give them assistance.

Thin-film technology is far from exhausted. New sectors are constantly discovering the advantages of enhanced surfaces.

Surface refinements with coatings as thin as skin currently offer a variety of potential applications in extremely varied areas of production. The improvement of the tribological properties such as scratch resistance, hardness, reduction in friction, and corrosion resistance

are already among the conventional areas of application. In the wear-reducing coating of cutting tools, the German industry currently occupies a leading position internationally.

However, particularly in high quality tools, the saturation limit for wear-resistant films has not yet been reached. In 1991 international sales in this sector for systems for the enhancement of tools and machine parts will amount to approximately 150 million German marks [DM]. Optics is another significant area of application for surface refinement. For example, in this field, architectural glass can be provided with a coating which significantly reduces heat absorption.

However, in contrast to the numerous laboratory and pilot systems using thin-film technology, there are only a few systems ready for industrial use. The high rejection rates due to film reproducibility which is not suitable for manufacturing and the still inadequate capability of quality control are currently hindering industrial applications. Furthermore, the demand for surface enhanced products is splintered into specialized markets where small systems can adequately meet the needs.

Many companies also shy away from the high costs linked to entry into this technology. The investments for a system for tool coating run approximately DM1 million, and that is only the hardware costs not including the expense for process optimization. This is not completely unproblematic precisely for the small and medium-sized companies active in these markets with a still largely uncertain potential.

Not least for these reasons, the industrial spread of thin-film technology has not advanced faster. About 70 German companies are involved in this area as system manufacturers and contract manufacturers. The application-specific expertise is concentrated with these high tech suppliers.

The application of surface refinement also makes new demands on the continued training of personnel. To date job profiles in the metal processing industry have been inadequately adapted to this technology. The necessary qualification is now being handled primarily within companies with the support of the unions through offerings of continuing education.

For companies, it is often difficult to obtain information about thin-film systems. Furthermore, the variety of processes does not make it any easier to understand this field, so that non-users frequently rule out the use of surface refinement in their own products for a long time. Positive initiatives for removing these deficiencies are, for example, data banks, such as the SchOHT-Information Exchange at the VDI Technology Center in Duesseldorf.

Because of increasingly stringent environmental regulations, the disposal of acid wastes from wet chemical processes is becoming increasingly problematic. PVD [physical vapor deposition] processes in particular offer

environmental advantages compared to electroplating. However, because of high costs incurred in the manufacture of coatings, electroplating technology will not lose significance in the foreseeable future.

The increasing importance of energy saving measures is opening additional markets to surface refinement. Low-transmission layers in architectural glass, which can reduce the primary energy demand in houses, promise a rapidly growing market.

New potential applications which result from thin-film technology are still in the research stage. Electrically conductive ceramic engines or automatic defogging windshields for cars are extremely promising examples for possible uses of surface refinement. Experts calculate that these products will be ready for the market in the mid-1990's.

But until then, extensive research work must be done to remain internationally competitive. However, the sectors, regions, and processes are inadequately coordinated. The danger that many commitments in this area which will prove to be cost effective only over the middle- or the long-term and consequently will not be tackled is very great at this stage. In light of the long-term Japanese plans, competitive disadvantages for the Germans could thus develop in the consumer markets.

World Market for Systems to Generate Thin Films (DM1 billion 1991) (Excluding Microelectronics Applications)

Optics	35%
Storage technology	18%
Mechanically resistant materials	15%
Optoelectronics	12%
Decorating	7%
Membrane technology	5%
Electronics	5%
Medical technology	2%

Source: In-house research

Fraunhofer R&D Center Established

92WS0157B Duesseldorf VDI NACHRICHTEN
in German 01 Nov 91 p 24

[Interview with Prof. Heinz Dimigen, Director of the Fraunhofer Institute for Surface Technology by A. Huelmann in Hamburg; time not specified: "Film Technology Is Becoming a Critical Competitive Factor": Thin-Film Technology: Research Making Refined Surfaces Marketable"; first paragraph is VDI NACHRICHTEN introduction]

[Text] Hamburg, 1 Nov (VDI-N)—Films as thin as skin have developed into a key technology in extremely varied production areas. To further expand the range of applications, a Fraunhofer Institute for Film and Surface Technology has been established in Hamburg. According

to Institute Director Prof. Heinz Dimigen, the potentials for application of thin-film technology are far from exhausted.

[Huelsmann] A whole Fraunhofer Institute has been tailor-made for film and surface technology. Do the results justify such an outlay for research?

[Dimigen] I believe I can answer that affirmatively with a clear conscience. Film processes have come of age through semiconductor technology; that was the foundation for the development. Not until the last 10 years was it discovered that these technologies offer an enormous potential for refining surfaces. The industry is faced with the problem of meeting the increasingly higher requirements placed on components in the optical, mechanical, or electronic sector. And only a film is capable of optimizing the surface regardless of the underlying material. For this reason, the institute will focus not merely on the development of such coatings, but on the entire range of applications from the improvement of manufacturing processes all the way to measurement technology.

[Huelsmann] Where is the future potential of thin-film technology?

[Dimigen] The spectrum of the area of application is vast and so far only very little of what is feasible has been done. An important focus will be the optimization of surfaces relative to friction and wear. Mechanical components, such as bearings, are still lubricated with oils and grease. That constitutes a large sphere of activity to replace hydrodynamic lubrication, not always desirable for environmental reasons, with films. An additional sphere of activity will involve energy saving measures. Here, for example, in the area of glass coating, the windows in homes could be optimized to improve the heat balance. In biotechnology and environmental technology, we haven't yet even scratched the surface of the potentials for application of this technology.

[Huelsmann] The attainable quality of films must be taken into account. Where are the economic limits?

[Dimigen] It is naturally very difficult to define the economic limits in this field since in many areas the processes have not yet left the research stage. However, development is moving sharply in the direction of cost reduction both for processes and for systems. One very significant factor in this connection will be the monitoring of manufacturing processes to improve product quality.

[Huelsmann] What process will nose ahead in the future?

[Dimigen] It is clear that costs are certainly the priority from the industrial standpoint. The process which produces a specific coating at the lowest costs will be preferred. However, the problem is not so simple. Because it has become obvious that the different applications in mechanics, optics, or electronics make different quality demands on surface refinement. For certain applications, expensive processes will be necessary.

Other products, for which the demands on the films are less critical, will manage with cheaper processes.

[Huelsmann] What can an institute like yours do for the industry to further advance thin-film technology?

[Dimigen] As a Fraunhofer Institute, we see ourselves as a link between pure research and industrial applications. In addition to the development of new coatings for industrial use, we must also provide for the cost effectiveness of the manufacturing processes. Furthermore, measurement technology is a significant factor in this area. Because for production, it will be essential to develop specifications for films quickly and reliably and to test them for their technical qualities.

[Huelsmann] Where do you rank German thin-film technology internationally?

[Dimigen] I believe that we are currently quite well positioned internationally in the application of surface optimization. Not the least because of the funding of the BMFT [Federal Ministry for Research and Technology], many projects were started which are now bearing fruit. This is particularly true for the development of coating processes and specific film systems, as well as the development of processes and systems for specification of coatings. Work on new systems, such as diamond layers, must absolutely be hurried along since Japan and the USA already have a considerable head start there. In the European context, I believe we enjoy a good position, which however must be further expanded, because this technology will be a very critical competitive factor in the future.

[Huelsmann] You just said that Japan and the USA are ahead of us. How can we eliminate this gap?

[Dimigen] Above all, we need well-coordinated research. Cooperation between industry and research facilities must be encouraged so that modern film systems, which can be used in a variety of ways and thus have strong influence on many industrial sectors, are quickly brought to a marketable level.

[Huelsmann] Where then do the strengths of German thin-film research lie?

[Dimigen] Our strengths lie in our capability for rapid development and implementation of film systems which are also then quickly brought to industrial use. It is clear that we are behind the Japanese and the Americans in a few areas; however, on the other hand, we have recently managed to gain experience in future-oriented developments and to catch up in expertise. In the fields of coatings and systems technology, we in Germany have absolutely efficient companies which occupy a good market position placing us among the leading countries in Europe in this sector. It is also significant that in

Germany the idea is increasingly taking hold that this technology is more than the mere development of a process or a film. Instead, it must be viewed as a system solution which places equal emphasis on the problems of the substrate, the specifications of the film, process control, quality, and, last but not least, environmentally compatible manufacture and system design.

[Huelsmann] Which films have the greatest future?

[Dimigen] The market for hard tribological coatings, such as titanium-nitride or cubic boron nitride (CBN) will continue to grow. Carbon-based coatings will also play a large role in the future. Everyone knows that diamond films offer quite critical advantages in mechanics, optics, and microelectronics. As a researcher in this field, I am asked to develop very specific surface coatings with specified characteristics because it is never the film itself that is sold but its desired function alone. The use of this technology in extremely varied industrial sectors will necessitate the development of a variety of optimized films.

[Box, p 24]

High Tech Glossary

CVD: Chemical vapor deposition, a coating method using gas decomposition at relatively high temperatures at atmospheric pressure.

Ion beam etching: Here accelerated ions are used to erode substrate material, for example, for the structuring of surfaces.

Ion beam milling, or ion beam engraving: In this method the ion beam is used as a stylus for the structuring of surfaces.

Ion beam mixing: A method in which the particles of coating impacting a substrate are mixed with the substrate material by means of a highly energized ion beam.

Ion plating: Ion-assisted vacuum coating process in which pretreatment of the substrate and subsequent condensation of the film material on the substrate take place under the influence of ion bombardment.

MBE: Molecular beam epitaxy, a vacuum process for separation of a monocrystalline thin film.

PVD: Physical vapor deposition, a mechanical coating process performed in a vacuum, e.g., vacuum deposition, sputtering, atomization, or ion plating.

Electronics, Optics Applications

92WS0157C Duesseldorf VDI NACHRICHTEN
in German 01 Nov 91 p 24

[Article by Hartmut Frey: "Ions Can Do More Than Harden Surfaces: Thin Film Technology: Proven Processes Obtain New Areas of Application"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 1 Nov (VDI-N)—In addition to tool coating, electronics and optics are increasingly involved in thin-film systems.

As a result of the strong developmental surge of recent years, thin-film systems are on the threshold of many high tech sectors. For many processes, potential uses are still far from exhausted. In a few areas of production, they long ago proved themselves in industrial use. However, in many areas, research is just beginning.

Ion implantation is only one example of the fact that some processes which have had a solid place in industrial production for a long time are just at the beginning of their potential in other areas. Ion implantation enjoyed its first successes in microelectronics. It was quickly recognized in wear research that the implantation of nitrogen ions in steels significantly increases the surface hardness of materials, resulting in drastic reductions in friction and wear.

Now the process is used industrially in many ways. This often involves contract companies specializing in this application which coat cut, stamped, and extruded tools using nitrogen implantation equipment.

However, other important properties of materials, such as the corrosion resistance of metals, can also be improved by this process. Preliminary indications of quality-enhancing treatment with ion beams have also been obtained for such futuristic materials as ceramics and polymers. With ion exposure before sintering, hardness, strength, and wear properties of hot-pressed ceramic parts can be improved.

High energy implantation offers particularly promising coatings. Using this process, high-temperature catalysis like that prevailing in engine combustion chambers can be significantly improved. Because at temperatures of approximately 1,000°C, materials such as platinum or ruthenium diffuse into metal materials, the catalysts cannot permanently adhere to the combustion chamber surfaces. With implantation in a thin ceramic film (20 to 30 microns), the diffusion can be largely suppressed.

Completely new potential results when polymers are bombarded with ions. The electrical conductivity of these insulators increases 14-fold and thus reaches the conductivity of graphite. Polymers made conductive by this process can, for example, replace metals as shielding for sensitive instruments against electromagnetic interference or even be used as electrodes in batteries.

Batteries equipped with polymers are significantly lighter than lead batteries, i.e., they deliver significantly more power per unit of weight. Furthermore, electrodes made of synthetics are significantly more durable since the ions involved in carrying and storing the charge come from the solution and not from the electrodes themselves. Additionally, in contrast to nickel-cadmium or lead-sulfuric acid batteries, polymer batteries contain no poison and environmentally hazardous materials, resulting in virtually no disposal problems.

However, not only surface properties can be improved with ion bombardment. Modern thin-film technology permits novel designs and structures of components even in electronics and optics. Instead of the simple binary electronic switches used in today's computers, which can only assume on or off status, it is possible to produce multipurpose switches which can be arranged so that they operate in parallel. This could lead to more efficient forms of computer logic as well as components for drastically miniaturized and faster circuits. But the "supercomputer on a single chip" about which some scientists are already talking is still a long way off.

Tiny lasers with high levels of efficiency which feed large quantities of light-encoded data into fiber optic networks of optical communications systems are within the realm of possibility based on the current level of thin-film technology. Such powerful data channels could carry an enormous flood of video, computer, and communications signals directly to the office, the car, or the home.

It remains to be seen whether these thin-film processes can make the long-cherished dream of optical electronic circuits which operate with both electrons and photons come true.

Philips to Build LCD Factory in Eindhoven

Factory to Use Own Technology

*92WS0080A Rotterdam NRC HANDELSBLAD
in Dutch 11 Oct 91 p 1*

[Article by Dick Wittenberg: "Philips Begins LCD Factory in Eindhoven"]

[Text] Eindhoven, 11 Oct—Philips is investing 200 million guilders in the mass production of active liquid crystal displays (LCD's). This is the first major investment in production since last year's reorganization.

The factory will be located in Eindhoven and is scheduled to be completed by the beginning of 1993. In the initial phase, the plant will provide 300 jobs, followed by an additional 150 later on.

Production is to be based on Philips' own technology, which is simpler and less expensive than that of Japanese competitors. Philips is still engaged in negotiations with companies that may be involved in the project.

During the course of its reorganization operations, Philips not only decided which activities to give up, but also chose a number of promising new market areas, in which it hopes to be able to play a prominent, lucrative role. LCD's are one such area, in addition to the digital compact cassette and the interactive compact disc.

Philips will be the first European company to produce active LCD's on a large scale. A large number of Japanese companies, including Sharp, Hitachi, Matsushita, and Seiko Epson, have already announced investments in the mass production of these displays. IBM has

entered into a joint venture with Toshiba for the development and production of large LCD's.

Market surveys have shown that annual sales of LCD's will grow to between 8 and 16 billion guilders within the next five years. Liquid crystal displays will not only be used as a replacement for the cathode-ray tube, a product where Philips is the worldwide market leader, but will also find applications in laptop computers, in automobile dashboards, and in telecommunication equipment.

The LCD factory in Eindhoven is housed in the former test factory for memory chips, which was forced to close at the end of last year because the company was pulling out of the market for that product.

Strategy Behind Decision

*92WS0080A Rotterdam NRC HANDELSBLAD
in Dutch 11 Oct 91 p 14*

[Article by Dick Wittenberg: "Philips Preparations for Production Like Those for Military Operation"]

[Text] Eindhoven, 11 Oct—Philips is negotiating with a number of companies that might be interested in being involved in the mass production of active liquid crystal displays (LCD's). This could lead to the establishment of a joint venture.

The LCD factory, which will be located in Eindhoven, would be included in such a joint venture. The most important advantage of this sort of arrangement, says Drs. A.H.A. Veenhof, head of the Liquid Crystal Video Products project, is that these partners could contribute applications that Philips does not have in-house. He declines to name the companies with which Philips is still negotiating.

According to plan, the LCD factory is due to begin supplying products during the first quarter of 1993. That is later than most of the Japanese competition—a year later than Sharp—but according to Veenhof it is just in time. He says that the market for active color LCD's will not explode until 1993. In addition, Philips is already producing liquid crystal displays on a modest scale at the Eindhoven test factory, which was set up four years ago for 100 million guilders.

The display consists of two thin glass plates, separated by clear liquid crystal and transparent electrodes. By applying current to the electrodes, it is possible to control the direction of the crystal molecules. Depending on their position, they let light through or block it.

LCD's have been used in digital clocks and pocket calculators for nearly 20 years. These are slow, crude displays, so-called passive LCD's. Although they are also used in television, among others by the Japanese company Casio, the result is a mediocre picture: poor contrast, low intensity, and inadequate sharpness.

Since the second half of the 1980's, most TV manufacturers have been experimenting with active LCD's, displays where each picture element is controlled separately. Because of innovations in light, material, and electronics, the picture quality of these displays is now comparable to that of the old-fashioned cathode-ray tube. Only the cost is substantially higher for the time being. In addition, there are still limits on the size of the displays. The largest LCD TV's sold in Japan have a picture diagonal of 10 inches, or approximately 25 cm.

Philips has developed its own patented technology for production of the displays. The Philips displays are simpler in construction, and are thus cheaper to produce. They require fewer process steps than the competitors' LCD's. This also means that Philips does not have to invest as much in production equipment. At the same time, the quality of the displays is better, according to independent specialists.

The preparations that are being made for mass production of the liquid crystal displays are like those for a military operation. The project began four and a half years ago by concentrating the resources of three product divisions and of the research department. The Components Division was in charge of the LCD's, the Light Division for the special lamps to illuminate the displays from behind, and the Consumer Electronics Division for translating this into products. The first three years were used primarily to scout out the technology and gather experience.

A year and a half ago, the project team selected four possible sites for the LCD factory: three in Europe and one in Japan. While a comparative study was launched into the advantages and drawbacks of each location, preparations began at all the sites. A construction plan was drawn up for each site, in order to avoid delays in the startup of mass production. Later, the possibility of setting up production in Taiwan was also studied and prepared for.

In anticipation of a company decision on the mass production of LCD's, the project group placed the first orders with manufacturers of production equipment at the end of last year. In so doing, Philips consciously ran the risk of incurring futile costs. Putting this off would have resulted in fatal delays.

In the meantime, moreover, the company had yet to even choose a technology. Philips played it safe by experimenting with thin film transistor technology, which is also being applied by the Japanese. At the same time, work continued on the company's own method.

During the second half of this past January, Philips held its first top-level consultation on the LCD's. This was attended by President Jan Timmer as well as other members of the Group Council. The international gathering also included top people from the various divisions and from Marantz, the Japanese subsidiary.

At the end of the meeting, the Group Council asked for more certainty concerning timing and technology. The Group Council wanted to make sure that Philips would be able to get housing, equipment, and qualified people in time in order to launch mass production on schedule. In addition, the Group Council wanted to know what risks were involved if the company were to choose its own technology. In the past, Philips had paid too much for training with its own technologies, which were superior on paper—the V2000 video system. In the meantime, the company once again authorized a number of preliminary investments necessary for the project to proceed.

Eventually, Philips chose the Eindhoven location, because buildings and personnel are most readily available there. The fact that the technology transfer from the Eindhoven test factory would go most smoothly with a location in the neighborhood also played a role. An additional reason for not locating the factory in the Far East was that the U.S. Government recently imposed a 63 percent anti-dumping duty surcharge on Japanese LCD's.

NUCLEAR R&D

Europeans Debate Need for Fast Breeder Reactors

92WS0140B Paris LE MONDE in French
3-4 Nov 91 p 13

[Article by special correspondent in Kyoto, Jean-Francois Augereau: "At the International Conference on the Future of Fast Reactors, the OECD Pleads for Breeder Reactors"]

[Text] Should we continue to develop breeder reactors? Should we continue to invest in reactors of this type, examples of which are the Phenix and Superphenix reactors, at a time when experts do not anticipate any economic outlets for these machines before 2010-2020? On Thursday 31 October, the general director of the OECD Nuclear Power Agency, Mr. Kunihiro Uematsu, answered these questions with a very firm yes.

At the close of the Kyoto international conference on the future of fast reactors, he actually urged the participants not to give up despite the fact that these programs are now at a low point, especially in Europe. "Certainly," he acknowledged, "it is obvious that we have today no vital need for breeder reactors. Of course, we also know that their construction costs will have to be considerably reduced to make them competitive with other types of reactors and to reduce by at least one third the price per kilowatt-hour produced, before we can hope to convince electric-power companies."

What is perhaps more essential, however, is the emphasis that Mr. Kunihiro Uematsu, as well as most Kyoto conference participants, placed on the fact that we should start to consider the problem of uranium reserves, which will not remain inexhaustible forever,

and the problem of nuclear waste, which is still greater today. From this point of view, experts say, tomorrow's breeder reactors will provide a good solution as they will be able to generate fuel (plutonium) and to burn certain noxious radioactive waste (the actinides).

Support From Club Members

The fact remains that research and development programs concerning these machines are currently somewhat "uncertain" and that, despite some stirrings concerning these subjects—e.g. the U.S. Department of Energy's published decision to revive its research on breeder reactors and spent-fuel reprocessing (ALMR, PRISM, and IFR programs [integrated fast reactor])—they need each other's help to survive. Hence this formidable need for mutual aid through cross-cooperation agreements between leading countries in this technology, so as not to lose any of what has been achieved, maintain their teams, and be ready for the day when the need for these reactors is felt.

The recent agreement between the Europeans and the Japanese (LE MONDE 30 October 1991), like the agreement between the Americans and the Europeans, is of this type. All actors in this worldwide nuclear play are aware that they cannot achieve anything without one another's help and that, as Mr. Kunihiko Uematsu reminded them, they must "pool their results, work together on safety-related problems, and above all define common safety rules."

No doubt, the road will be long and difficult. Everyone feels prepared to support those who, for budget reasons, might have to leave the club of breeder-reactor manufacturers. To begin with, the Japanese who, despite their ambitious nuclear program¹ and very sizeable breeder-reactor research and development budgets, would very much like not to stand alone on the world scene at a time when their Monju 280-MW breeder reactor is about to become operational.

And, even though Mr. Uematsu did not say so, it is clear that his position in favor of this type of reactor had a more nationalist tone than would have appeared a priori.

Footnotes

1. In July 1990, a report of the Japanese Ministry of International Trade and Industry (MITI) recommended to more than double Japan's nuclear capacity, from 28.9 gigawatts in 1988 to 72.5 gigawatts in 2010.

CERN Magnet Prototype Sets World Record

92WS0178B Paris AFP SCIENCES in French
14 Nov 91 pp 19, 20

[Article: "World Record in Accelerator Magnets Set at CERN"]

[Text] Paris—A new world record for accelerator magnets has been set by the European Particle Physics Laboratory (CERN [European Nuclear Research

Center]) in Geneva: On 21 October, a 1-meter-long prototype of the double dipole magnet that will go into the future LHC (Large Hadron Collider) produced a magnetic loading force of 10 teslas (10 webers of magnetic flux per square meter) in the two beam channels, at a temperature of 1.8 Kelvin.

CERN's LHC development group performed the test on a prototype built in France by the Jeumont-Schneider firm, using a superconducting niobium-titanium cable provided by Alstom-Intermagnetics. It was an important step forward in development of the LHC magnets that are to be built into the 27-kilometer ring of the LEP (Large Electron-Positron Collider).

The plan now being studied calls for installing the LHC above the LEP, in the tunnel designed to house both rings. In the LHC ring, two proton beams will be accelerated toward each other at 16 trillion volts, subjecting their constituents—quarks and gluons—to the force of a trillion-volt collision. At that high energy level, physicists believe they can detect new particles, including the hypothetical Higgs boson.

Controlling the motion of particles in the two LHC rings will require the most powerful magnetic deflection ever produced in a particle accelerator: 10 teslas. The power of Fermilab's Tevatron in Chicago is only 4 teslas, while that of the HERA (Electron-Proton Collider) going into service at Hamburg's DESY laboratory is 6 teslas. The superconducting supercollider (SSC) expected to be built in Texas will produce only 6.6 teslas.

The LHC will have nearly 1,800 10-meter-long superconducting deflection magnets. The most innovative feature of the collider: the magnetic channels of the two beams will be housed in the same magnetic yoke, which will be kept at an extremely low temperature inside a cryostat.

CERN last year ordered ten 10-m dipolar magnets from four suppliers: Ansaldo (Germany), Noell (Germany), a group formed by Elin (Austria) and Holec (Netherlands), and a French group formed by GEC Alstom and Jeumont-Schneider.

JET Reports Success in Thermonuclear Fusion, Plans Fusion Reactor

92WS0140A Paris LE MONDE in French
12 Nov 91 p 20

[Article by Jean-Francois Augereau: "Looking for a Quasi-Unlimited Source of Energy, the Europeans Take a Decisive Step Toward Thermonuclear Fusion"—first paragraph is LE MONDE introduction]

[Text] European physicists appear to have taken a big step forward on Saturday 9 November, in Culham (Great-Britain), when they produced energy through nuclear fusion. This is a decisive stage in a process that should lead to the harnessing of a nearly inexhaustible source of energy.

Was it the event all physicists had been waiting for? It probably was if we are to believe officials at the Culham Joint European Torus (JET) where, in a sort of large metallic inner-tube a few meters in diameter, physicists managed to "put the Sun in a bottle" for an instant and produced "a significant quantity of energy through nuclear fusion."

In fact, for the first time ever, JET physicists succeeded in achieving the fusion of a sufficient number of hydrogen atoms—deuterium and tritium—to produce a little over one megawatt [MW] for two seconds. Compared with nuclear power plants which use fission (breaking down heavy nuclei such as uranium into smaller pieces to produce energy), the figures achieved in Culham may seem ridiculously small. Indeed, the Fessenheim, Nogent, Tricastin, or Bugey power plants supply the EDF [French Electricity Company] power-supply network with 1,000 MW of electricity around the clock.

Why try the impossible and attempt to "ape" the stars, which can produce torrents of energy by making hydrogen atoms fuse to form another element, helium? Why attempt to imitate the Sun, which practices that type of conversion at a mind-boggling rate, and has been doing so for nearly five billion years?

The reason is simple: thermonuclear fusion, if it is ever controlled and easily reproducible, would provide mankind with a quasi-unlimited amount of available energy. The stakes are such that, for over 20 years, the Americans, the Soviets, the Japanese, and the Europeans have engaged in an unrelenting race to try and harness fusion reactions through machines derived from Soviet designs, the Tokamaks, which are called JET and Tore-Supra in Europe, TFTR (Tokamak Fusion Test Reactor) in the United States, JT-60 in Japan, and T-15 in the Soviet Union.

Day after day, physicists have made progress... with difficulty. Because although man readily learned to produce uncontrolled thermonuclear fusion in "H" bombs, he still finds it difficult to control such colossal forces in a machine.

300 Million Degrees

To achieve what physicists call the "break-even" point, that point in machine operation after which as much energy is produced in the reactor as is put into it, temperatures of 200 to 300 million degrees must be reached. And that is not enough. It must be possible to sustain these reactions for a sufficiently long period and with a sufficiently high density of matter in the machine.

Today, although it is one of the best machines in the world, the JET still has a long way to go before it reaches that threshold. By demonstrating twice on Saturday that the JET could produce energy with a small amount of tritium (0.2 gram, i.e. 14 percent of the mix), the European physicists opened a door in front of which many had been camping for a long time.

This experiment should boost research and enable the Europeans to better negotiate their position in projects concerning the ITER [international thermonuclear experimental reactor] and NET [Next European Torus] next-generation machines (LE MONDE 14 November 1990). These machines will be able to deliver five times more power than required to reach the break-even point, during a still limited but nevertheless considerable time (about 1,000 seconds instead of one or two), thus demonstrating that controlled fusion makes sense.

Although, according to Mr. Paul Rebut, one of the JET's fathers, the results achieved on the JET until 1996 will make it possible to design "an experimental fusion reactor capable of releasing over 1,000 MW of energy," it will take at least until 2040 before we can hope to develop a truly commercial reactor.

France, Japan Sign Nuclear Generator Cooperation Accord

92WS0143B Paris AFP SCIENCES in French
31 Oct 91 pp 18, 19

[Text] Kyoto—Europe and Japan decided to boost their cooperation in nuclear research by signing an agreement protocol on supergenerators in Kyoto on 28 October. The signing of the agreement marked the first day of the fifth international conference on fast neutron reactors and the fuel-cycle problems they generate.

The accord was signed by Mr. Minoru Okabe, president of the electrical power company JAPC (Japan Atomic Power Company) and of the research and development committee on fast reactors, and his European counterpart Mr. Hans Hennies (Germany). Its terms provide for an exchange of knowledge, technical know-how, ideas, and even researchers between the two parties, with the possibility of concluding more specific agreements on one or another aspect.

"Each one will pay his own share; there is no financial agreement. We already have an agreement of the same type with the Americans, but we are very happy to sign one with Europe, for it is considered the leader in fast neutrons," said the JAPC president.

As a replacement for reactors in current nuclear power plants (which use water pressure or boiling water), specialists believe that in 20 or 30 years plutonium-burning "fast reactors" will be a way of solving some of the problems associated with the downstream phase of the nuclear fuel cycle. One such problem is how to store waste with differing lifespans, which may grow in volume. Fast reactors may also be a way of limiting the risks of nuclear proliferation.

According to Mr. Jacques Bouchard, nuclear reactors director of the Atomic Energy Commission (CEA), Europe "has not yet lost its lead", despite the pressures of environmentalists and economic problems. It gained its expertise from work on the French (Rapsodie, Phenix,

and Superphenix) and English supergenerators, and from German research in the field. "But," he adds, "we must be careful."

Indeed, the three big players in Europe—France, the United Kingdom, and Germany—devoted a total of 600 million French francs [Fr] to "fast" research in 1991, or half as much as Japan and the United States. It was on the strength of an alliance that stretches back to 1984 and that was confirmed 16 February, 1989 that the French, English, and Germans opted to work together in cooperation with the Japanese.

The Europeans are studying the EFR (European Fast Reactor), a 1,500 megawatt fast reactor. Plans for it will be better defined within the next two or three years, when its political and technical fates are decided. The Japanese are wrapping up construction of their experimental supergenerator Monju, which should go critical in October 1992 and be used to prepare the DFBR (demonstrator fast reactor) of the early 21st century.

"The agreement that has just been signed does not link their fates, but will allow for an exchange of ideas and equipment, and the use of test rigs the two parties have in place," noted Mr. Bouchard. Presented in Kyoto as a possible solution to the problems inherent in fast reactors, [the DFBR] will be a small 300 MW reactor capable of functioning in groups of six to nine and of being combined on the same site with an advanced retreatment plant for irradiated fuels.

In the view of the some 150 specialists who will meet in Kyoto through Friday, fast reactors, provided that they are more reliable and less costly than current ones, are the solution to the energy problems of the first half of the 21st century.

Italy: Research Institute Develops Laser System for Tokamaks

92MI0156 Milan *L'ELETTRONICA* in Italian
Nov 91 pp 988-989

[Text] CISE [Center for Data, Studies, and Experimentation] of Segrate has developed diagnostics for plasma generated in controlled nuclear fusion experiments. The system, fully developed and constructed in Italy, uses neodymium power laser and can simultaneously measure plasma temperature and density at 18 points along the diameter of the cross section of the tokamak under study.

Tokamaks (two in Italy, and more than 25 in the world), are the most widely-used devices for the study of controlled nuclear fusion. Their structure consists of a vacuum toroidal chamber surrounded by a system of coils to generate a high-intensity magnetic field, and designed to confine the plasma generated within the vacuum chamber. Such a plant can generate plasma at a temperature of more than 50 million degrees for a few seconds; both the temperature and density of the generated plasma must be kept under control.

The system developed by CISE laboratories—similar to that recently devised and developed for ENEA's [Agency for New Technology, Energy, and the Environment] (Frascati Tokamak Upgrade) plant—is for the new tokamak being set up at the CNR [National Research Council] Ionized Gas Laboratory at the University of Padua.

The system has an Nd:YLF crystal oscillator that is inserted into a Gaussian resonator of the confocal type operating with gigantic impulses and creates laser impulses ranging between 250-300 mJ (see figure 1) [not shown]. The laser energy can be increased up to approximately 1 J/impulse through a second Nd:YLF bar used as a preamplifying stage. The active material used for the final amplification stage consists of a rectangular phosphate neodymium-slab operating at double speed with zigzag geometry. To achieve a good combination between the circular section beam emitted by the amplifier and the incoming rectangular surface of the slab, two cascaded telescopes, each with 2X magnification, were inserted between the two stages. After two passages through the slab, the laser output impulses that are generated have the following characteristics: energy/impulse = 10J; impulse duration = 10 nanoseconds; divergence (full angle) ≤ 0.5 mrad.

The system makes it possible to generate over the span of 100 milliseconds, a series of ten impulses with a minimal distance 10 milliseconds between each other. The extremely short duration of the generated impulses produces exceptionally high impulse power (in the gigawatt region), with relatively modest energies (see figure 2) [not shown].

Figure 3 [not shown] shows that, after being reflected several times, the laser light beam (coherent and monochromatic light) passes through the FTU high-vacuum chamber where it interacts with the plasma free electrons, which act as oscillating electrical dipoles (Thomson effect), it loses its original coherent and monochromatic properties and is collected, by a special multichannel optical system as it exits the vacuum chamber. Finally, a complex system of sensor-detectors performs a spectral analysis of diffused light.

Since the number of diffused photons grows with the density of the plasma, while the dispersion of the diffused light frequency depends on the plasma temperature, the analysis provides information on the density and temperature of the plasma that is generated and magnetically confined within the tokamak.

CISE (99 percent ENEL [National Electric Power Company], 1 percent Milan Municipal Energy Company, and a symbolic share owned by the Milan Town Council) is an applied research company that develops innovative technologies for certain fundamental sectors: energy production, environmental protection, the manufacturing industry, the aerospace industry, the conservation of our cultural heritage. More specifically, in the field of plasma diagnostics, CISE developed the same kind of

machine as above for CNEIC (China Nuclear Energy Industry) in 1986. A second advanced measuring instrument was supplied to the ENEA laboratories in Frascati in 1990.

CISE is one of the founders of EACRO (European Association of Contract Research Organizations) and EMARC (European Materials Research Consortium).

Karlsruhe Research Center Develops Cosmic Particle Array Detector

*92WS0156 Duesseldorf VDI NACHRICHTEN
in German 01 Nov 91 p 22*

[Article by Dietrich Zimmermann: "Karlsruhe is Developing 'Kascade', a Giant Particle Research Instrument—Cosmic Radiation Trap—Plans for 50,000 Square Meter Detector"]

[Text] When cosmic radiation hits the earth's atmosphere, it produces cascades of particles. "Kascade" is also the name of a new large-scale physics experiment designed to find out more about these cosmic showers.

Viennese physicist and nobel laureate Viktor Franz Hess discovered cosmic radiation in 1912, approximately at the same time when nuclear physics came into being. At that time, Hess and Werner Kolhoerster had gone up to a height of 5,000 m in a free balloon to measure atmospheric electricity. During these measurements they found that their instruments for measuring charges (electroscopes) discharged at an increasingly faster rate as they climbed higher. They concluded quite correctly that there must be ionizing radiation coming from space.

Since the energy of this "cosmic radiation" was many times more intense than that of any radiation source on earth, it became an indispensable tool of particle research in the following decades. In 1932, for instance, positrons, i.e. the electron counterparts consisting of anti-matter, were discovered in cosmic radiation, and later mesons, pions and hyperons. However, when the era of high-energy accelerators started in the late 1950s, interest in this type of particle research decreased considerably. While the particle energies obtained by circular accelerators, e.g. in the European Laboratory for Particle Physics (Cern) in Geneva or in the German Electron Synchrotron (Desy) in Hamburg, are not as strong as those that can be found in cosmic radiation, these instruments provide precise and exactly reproducible test conditions, which considerably facilitates verification of discoveries.

There are two distinct types of cosmic rays: primary and secondary rays. Primary radiation emanates from special star systems such as the centers of galaxies, or it is the result of spectacular events such as the catastrophic destruction of a star in a supernova explosion. It is primarily particles with a mass, in particular atomic nuclei and to a lesser extent electrons, that travel space almost at will until they hit an object such as the planet earth, and—in the case of earth—violently interact with

its atmosphere. During this process, the enormous energy of the minute space projectiles penetrating the atmosphere is transformed into many new particles. These secondary particles continue this process and produce further generations of secondary particles, so that a large area of particles is quickly forming around the incoming direction of a primary particle.

While repeated attempts were made to register the early secondary particles of such cascades or even the primary particles themselves with detectors on satellites or space shuttles, the detector areas used were so small that the measuring times had to be very long. Therefore, large detector areas were used on the ground in an attempt to "catch" the particle showers measuring up to 100 m. Even this has not been enough, since too few detection devices were used on these areas and therefore only a few particles of a cascade could be detected. In addition, the composition of these cascades can be very different even if they are generated by identical primary particles with comparable energy.

Therefore, obtaining many measured values for many particles of a cascade requires the use of a costly giant detector. This is exactly what Kascade is, the Karlsruhe Shower Core and Array Detector. The "array" consists of 316 identical detector stations with a base area of 200 x 250 m or a total of 50,000 square meters. Sixteen detectors each are combined into a so-called cluster. The core is the central detector located almost directly in the middle of this field. This central detector has an area of 20 x 16 m and a height of 2.2 m and consists of concrete, plates made of iron and interspaced layers with a total of 10,000 detectors of the liquid ionization chamber type as well as many multi-wire proportional counters in the "basement" of the huge block.

The array detectors will be used to detect the "soft" components of the cosmic showers, i.e. electrons and gamma quanta, but also muons, i.e. particles with a very short life which are transformed into different particles almost immediately after they appear. Each detector consists of four stainless steel cones covered with sheet lead. The wide end of the cone has a 1 m diameter. The bottom of these "funnels" is covered with an organic liquid which flashes minute "sparks" when hit by an electron or gamma quantum. This dim light is detected by a light amplifier in the tapered end of the cone and registered. In addition, these four cones are positioned next to each other on two plates, one made of 10 cm thick lead and the other made of 4 cm thick iron with a muon detector underneath. By precisely connecting all electron detectors, a cascade's angle of incidence can be determined with a precision of less than one degree.

The central detector is even more complicated than the array detectors. It is used to detect "remnants" of the primary particle in the shower core which still has enormous amounts of energy. In principle, this is accomplished by guiding them into a type of "cake" consisting of iron and detector layers. These layered detectors are then used to

determine how far the particle has penetrated the iron and in what iron layer it finally got stuck. This requires no less than 3,500 t iron, mostly in the form of 8 to 12 cm thick plates. This is a lot and can be financed only because scrap metal is available, which was left over when the previous atomic plant Niederaichbach was dismantled.

German Synchrotron Achieves First Electron-Proton Collision

92MI0073 Bonn DIE WELT in German 26 Oct 91 p 18

[Article by Lutz Bloos: "When Particles Collide: First Collision Between Protons and Electrons"]

[Text] Particle physicists at the German Electron Synchrotron (DESY) in Hamburg have succeeded earlier than expected in producing the first collisions between electrons and protons, which are around 1,800 times heavier. The protons had been accelerated to 480 gigaelectron volts (GeV), and the electrons to 12 GeV, around half the energy that will subsequently be used in experiments. A GeV is the energy acquired by an electron when it passes through one billion volts.

Following Federal Research Minister Heinz Riesenhuber's activation of the new particle accelerator HERA [Hadron-Electron Ring Accelerator] just a year ago, this achievement confirms that the technical concept behind the accelerator works. "Though it had looked for some weeks as if there would soon be a successful collision, the minutes before it happened were very tense ones," states Petra Harms, DESY's press officer, describing the situation in the control room. "The system had to be very finely tuned in order to position the particle bundles in the ring to an accuracy of one tenth of a millimeter," she explains. The timing achieved was accurate to about a billionth of a second.

A week ago each ring had only one particle cluster the size of a pin stored in it. Two billion electrons and 10 billion protons orbited the 6.3-km long ring in vacuum tubes 50,000 times per second, close to the speed of light, colliding with each other in the process. During operation for research purposes, each tube will contain 210 clusters, so the number of collisions will be correspondingly greater.

Electrons and protons circulate in opposite directions in two high-vacuum tubes positioned one above the other in the HERA tunnel. As the electrons lose approximately 0.5 percent of their energy each time around, in the form of synchrotron radiation, superconductive high frequency resonators provide extra thrust, while deflection and focusing magnets keep the particles exactly on course. Although the protons require no fresh energy in the ring, they do require far more powerful magnets to hold them on course. These magnets are superconductive and are cooled to -269°C with liquid helium; this is why Europe's most efficient helium cooling plant was constructed for HERA.

The particle energy will gradually be increased over the coming weeks and the behavior of the particle radiation

will be closely observed. As beam control was so outstandingly successful for the first collision, a start is expected to be made on moving the two detectors "Zeus" and "H 1"—each of which weighs over 3,000 tons—into the beams in December; this process will take around three months.

HERA is basically a powerful electron microscope for studying minute material structures. The particle energy generated makes it possible to hit individual quark particles inside a proton with an electron, and then to study the result. If an electron collides with a quark, it can eject it from its very strong bond within the proton. Quark-antiquark pairs that, as it were, "condense" out of the reaction energy are thus formed. The pairs then combine to form baryons, each of which has three quarks and mesons (quark-antiquark pairs); these are detected by the detector.

As only around half a proton's mass is concentrated in the quarks, the other half must lie in what are called the gluons, which the quarks exchange among each other. They cause the strongest bond known to nature. The electron may also collide with a gluon; these collisions provide further insights into the physics of atomic bonding.

All previous experiments have shown electrons and quarks to be noncomposite, i.e., elementary particles. As HERA can identify far smaller structures than all previous experiments with particle accelerators, physicists hope for further insights into the quarks enclosed within protons and the extremely strong force that binds them.

The HERA experiments should be seen within a wider context, however. Throughout the world physicists are seeking to formulate a unified theory of matter that will incontrovertibly unify the four known forces. This has so far been successfully achieved with electromagnetic and weak nuclear force. Steven Weinberg and Abdus Salam received the 1979 Nobel Prize for Physics for their theory of electro-weak [elektroschwach] forces which has since been proved experimentally.

The next target is to include strong nuclear force, which holds the nuclear particles, neutrons and protons, together. Previous attempts have been known by the name 'Grand Unified Theories'; however, to date there have been no experimental results to confirm one theory or another.

The ultimate aim is to include gravitation in quantum dynamics. However, all attempts to describe it in terms of quantum dynamics have so far failed. The first attempts to do so led to bizarre results that have remained a matter of controversy among experts.

SUPERCONDUCTIVITY

Interest in Superconducting Ceramic Perovskites

ESPRIT Research Funding Requested

92WS0215 Paris *LE MONDE* in French 04 Dec 91
pp 17, 19

[Article by Jean-Paul Dufour: "Molecules Without Frontiers"—first paragraph is *LE MONDE* introduction]

[Text] After ceramics, organic materials could push back the limits of superconductivity.

In 1986, when Alexander Mueller and Georg Bednorz announced that they had discovered a material that was superconductive at 35 degrees Kelvin [K] (-238°C), all physicists knew that their two colleagues had joined straight away the brotherhood of Nobel candidates. The quick reaction of the Swedish Science Academy jury who awarded them the Nobel prize the very next year—something extremely rare—testified, if needed be, to the importance of the breakthrough achieved by the two researchers at the IBM Laboratory in Zurich.

However, we have known for 80 years that some materials will conduct electric current without any resistance or energy loss. As soon as the phenomenon was discovered in 1911 by the Dutch Heike Kamerlingh-Onnes (1913 Nobel prize), everybody became aware of the prodigious interest it presented for the industry. And physicists, therefore, never stopped attempting to raise the "critical temperature" at which superconductivity appears, which unfortunately is very low. Until 1986, however, their efforts were very poorly rewarded. No matter how researchers would vary the compositions of the metallic alloys on which they were working, they would come against an apparently insuperable limit at 23 K (-250°C).

A New Plateau

Mueller and Bednorz' stroke of genius was to give up metallic alloys and turn to copper-oxide-based ceramic compounds, the "perovskites," although they are not as conductive as metals. Euphoria reigned for about two years. Records were being beaten one after the other. Today, however, it seems that a new limit has been reached, around -150°C. "It is true that we have now reached a plateau," Bernard Raveau, head of the Superconducting Materials Center at Caen (Calvados), acknowledged, and research now focuses essentially on forming (wire and thin layers), and on controlling all the characteristics of these new materials.

This, of course, does not prevent physicists and chemists from trying to advance, one degree at a time, to achieve (why not?) superconductivity at room temperature. For the time being, no one can say whether this dream can become reality. An increasing number of researchers believe that a new breakthrough might be possible with organic superconductors—sorts of "plastics" that will

conduct electricity—and especially with "fullerenes," curious football-shaped carbon molecules discovered in 1985, which have proved superconductive under certain conditions (*LE MONDE*, 12 June). Actually, three recent papers by American and French researchers¹ indicate that we might at last begin to understand how this surprising phenomenon works.

To assess the importance of this research, we should know that the first explanation of superconductivity was published only in 1957 (46 years after the phenomenon was discovered) by the Americans John Bardeen, Leon Cooper, and John Schrieffer. The so-called "BCS theory" shows schematically that superconductivity will appear when electrons (whose flow produces electricity) travel coupled in pairs (the "Cooper pairs"). This pairing of two particles which normally repel each other is possible only through the intervention of an external force. The BCS theory attributes it to 'phonons,' acoustic-type vibrations caused within a metal crystal lattice by the movement of a row of atoms.

This superb theory, whose authors were awarded the Nobel prize for physics in 1972, has only one fault, but it is a big one: apparently, it is valid only for metallic alloys. Since Mueller and Bednorz' discovery, therefore, theoreticians have been trying to find another explanation for superconductivity in ceramics called perovskites. Their results are not very convincing: to date, all they have achieved was to divide themselves into two antagonistic groups. One group, headed by the American Philip Anderson, among others, holds that electron pairing does not occur in the new superconductors. According to the other group, the "Cooper pairs" still underlie the phenomenon, but they form according to a different mechanism, which has nothing to do with phonons.

Renewed Interest

To overcome this new obstacle, an increasing number of theoreticians are turning to the fullerenes and, more generally, to molecular materials presenting superconductivity phenomena. "I get the impression that the scientific community is now rediscovering organic superconductors," the French physicist Denis Jerome remarked, somewhat disillusioned. The reason for this renewed interest? "Large organic molecules are interesting models that can be manipulated to alter their properties at will, far more easily than the crystal lattices of metals or perovskites."

A researcher at the Orsay (Essonne) Solid-State Physics Laboratory (CNRS [National Center for Scientific Research], Paris-Sud University), Denis Jerome, working with the Danish chemist Klaus Bechgaard, discovered the first organic superconductor in 1979. It is a molecule with a mile-long name, more commonly called by its formula: (TMTSF) 2PF₆. "It took us six years of work," he recalled. "The Americans started at the same time as we did, in 1973, but they gave up after

three years, with their credits cut off for lack of results." The CNRS apathy can sometimes be a good thing!

Nevertheless, it took Jerome and Bechgaard another 10 years or so to raise the "critical temperature" of their compounds to 13 K (-260°C), 10 degrees below that of niobium metallic alloys, 110°C below that of the perovskites. And, for many scientists, molecular superconductors might have remained mere laboratory curiosities, scientifically interesting but not very promising in terms of applications, if the emergence of the fullerenes had not led to renewed interest in them.

Less than one year after discovering that the fullerenes could become superconductive when "doped" with metal ions, researchers were able to achieve critical temperatures of 33 K (-240°C), comparable to those of the first perovskite ceramics.

Last month, in the same issue of the scientific magazine *SCIENCE*, two American research groups proposed apparently contradicting theories on fullerene superconductivity.

Sudip Chakravarty and his co-workers (University of California) lean toward an interpretation close to that of Philip Anderson. Chandra Varma and his team (AT&T Bell Laboratories), for their part, estimate that internal vibrations in fullerene molecules might be at the origin of the force that causes electrons to link in pairs.

Vibrating Atoms

Experiments made at Orsay by Denis Jerome seem to support Chandra Varma's theory. The French physicist and his team, working with researchers from Nantes, were actually able to prove that the vibration frequency of carbon atoms within the organic molecules they are studying is directly linked to the critical temperature at which the superconductivity phenomenon appears. "We can therefore think that the energy involved in these vibrations is what causes the formation of Cooper pairs at the very localized molecular scale," Denis Jerome concluded. An extrapolation to the fullerenes is tempting, to the extent that these molecules contain 60 carbon atoms (more in the case of some varieties) that vibrate in the same manner.

These first results might pave the way for a strong and verified theory of the superconductivity of molecular materials, pending another one that would apply to the materials used by Mueller and Bednorz. These theories might provide bench scientists with the weapons they lack to overcome the obstacles that still separate them from truly "high" temperature superconductors, close to room temperature.

This is certainly still a distant goal. Nevertheless, it is promising enough to cause the French, Danish, Italian, German, and Portuguese researchers who are working together on this subject, to file an application for financing under the European research program ESPRIT [European Strategic Programs for Research and Development in Information Technology].

Footnotes

1. "Superconductivity in the Fullerenes," by C.M. Varma, J. Zaanen, and K. Raghavachari (AT&T Bell Laboratories in Murray Hill), in *SCIENCE*, 15 November; "Electronic Correlation Effects and Superconductivity in Doped Fullerenes," by Sudip Chakravarty, Martin Gelfand, and Stephen Kivelson (University of California, Los Angeles), in *SCIENCE*, 15 November; "Giant Isotope Effects in Quasi Two Dimensional Organic Superconductors," by V. Merzhanov, P. Auban Senzier, C. Bourbonnais, D. Jerome, C. Lenoir, and P. Batail (Solid-State Physics Laboratory, Paris-Sud-Orsay University), and J. P. Buisson and S. Lefrant (Crystal Physics Laboratory, Nantes University), submitted to the weekly *NATURE*.

Applications Discussed

92WS0215 Paris *LE MONDE* in French 04
Dec 91 p 19

[Article by Jean-Paul Dufour: "Computers and Turbo-generators"]

[Text] From large electric equipment to electronics, there are many potential applications for superconducting materials. For several years already, niobium-based alloys cooled with liquid helium (at -269°C) have been used in the large electromagnets of some particle accelerators or of hospitals' nuclear magnetic resonance (NMR) equipment.

The emergence of perovskite ceramics superconductive at -150°C will make it possible to replace helium, which is expensive and difficult to handle, with liquid nitrogen (-196°C), which is inexpensive and commonly used in the industry, for refrigeration. Unfortunately, these new materials are difficult to use, for instance as wires. They must also withstand very-high-intensity currents without losing their properties; this is not always the case at present. It will probably take years of additional research before they become commercially available.

For the moment, the operational use of perovskites is restricted to prototypes of "Josephson junctions" (electronic components) and "squids," devices that will detect extremely weak magnetic fields and are used in particle physics, in neurology to study how the brain functions, and by the military to detect submarines.

According to a Siemens study made in 1989, the new superconductors will probably be very useful in electric turbogenerators, in industrial electromagnets, in huge underground superconducting coils designed to store electricity, and above all in data processing, for very-high-frequency transmissions.

On the other hand, the savings achieved by switching from helium to nitrogen is expected to be "average" for the large electromagnets used in accelerators of NMR

equipment, and negligible for magnetic levitation trains, which are therefore not about to leave the prototype stage.

Similarly, the additional cost resulting from the use of superconductors for power lines might be far from offset by the elimination of energy losses (8 to 10 percent in traditional networks). In addition, these lines would be far too fragile.

TELECOMMUNICATIONS

EC Discusses Difficulties in Implementing D2 Mac Standard

92WS0112E Paris LE MONDE in French
5 Nov 91 p 28

[Article: "European Commission Encounters Difficulties in Imposing D2 Mac Standard"]

[Text] This week the council of ministers responsible for European Economic Community telecommunications is going to turn its attention to the issue of transitional high-definition television [HDTV] standards. The draft European directive adopted by the EC last summer (LE MONDE of 26 June) and defended by EC vice president Filippo Maria Pandolfi imposes the D2 Mac standard on all television satellites as of 1 January 1992. The directive has been given a hostile reception by German, British, Danish and especially Luxembourg broadcasters. The manufacturers, including Philips and Thomson, say they can make no more progress until satellite television programs use the new standard.

If the directive remains in limbo, Europe will run into a juridical vacuum: The directive imposing use of D2 Mac only on direct satellite broadcasters (such as TDF 1) expires on 31 December, and the "simulcast" process (simultaneous broadcast in Pal or Secam and D2 Mac) is far from unanimously accepted. Mr. Pandolfi, in order to diffuse opposition, has promised an appropriation of 700 million French francs [Fr] for television broadcasters and producers to cover the extra costs of broadcasting programs in D2 Mac. But time is of the essence.

The president and general manager of Canal Plus, Mr. Andre Rousselet, who met with the EC vice president last week, told LES ECHOS on 4 November that "the aid offered by Brussels, which has used coercion and financial aid in an effort to convince the broadcasters—who are opposed to any investment and still somewhat skeptical of D2 Mac—to equip themselves to meet this standard" was "unsatisfactory," because it smacks of the "carrot and stick method." Mr. Rousselet noted that "broadcasts could be financed by the Commission, which might guarantee payment of the transmitters and perhaps other costs as well." He also urged "manufacturers and broadcasters to do their bit" in the face of "Japanese realities," such as the financial cooperation on HDTV between Japanese public television (NHK) and industry's Sony.

Transmission Capacity of Proposed European HDTV Deemed Insufficient

92WS0139A Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 18 Oct 91 p 8

[Unattributed article: "Will High Resolution Television Founder Because of Inadequate Transmission Capacity? Peyrat: Astra 1D Is Exclusively a Backup for Other Astra Satellites"]

[Text] Munich—"High resolution television only makes sense in conjunction with a very large screen which will not be available in a commercially viable form until the end of this decade. The HD-MAC system currently propagated, but not yet defined down to its last details, is an analog process and, consequently, actually an outdated system. It cannot carry high resolution images via ground-based transmitters, and useable satellites are not available for broadcast coverage of all of Europe. Satellites currently in use, such as Astra and Kopernikus, do not offer adequate transmission bandwidths." This has now been indicated by Dr. Pierre Meyrat, general manager of SES, which operates Astra in Luxembourg.

He added that the broad band satellite transmission of high resolution television programs on the ground would, for technical reasons, require receiving reflectors of a diameter of 180 centimeters, in contrast with the current ones with diameters of 60 centimeters. If taken literally, this statement is virtually a death sentence for the HDTV preparations which have been conducted at such great expense: Nothing goes via transmitters on the ground, and only via satellites if the service level shrinks to local dimensions.

The blame for this goes to the bandwidth of the high resolution signal compared to that of today's 625-line television. HD-MAC is still an analog system as far as the image is concerned. If it were converted to digital technology, which would in principle be possible, then the bandwidth increases significantly at first, but the capabilities for bit-rate reduction could ultimately bring the transmission bandwidth and the satellite transmission power required for it to a reasonable level. This conversion of HD-MAC from analog to digital would, at least according to specialists in the industry, result in two additional years of development and many millions in additional costs.

The Japanese industry is having the same difficulties with its so-called Muse transmission system, because it is also analog. They are overcoming them with their own HDTV satellites with adequate power and bandwidths—which is, however, an expensive solution. In Munich Meyrat was asked whether his fourth satellite Astra 1D planned for 1994 would be able to transmit high resolution television if it did away with some of the 16 channels, and with the HD-MAC process. Peyrat stressed that Astra 1D is designed exclusively as a backup for the other Astra satellites to avoid program interruptions in the event of breakdowns. However, the

SES company explained among other things in its newsletter of December of last year, that Astra 1D would technically be capable of distributing true European HDTV, for which even parabolic reflectors with diameters of 60 cm would suffice.

That Meyrat is still in the forefront of the opponents of that directive from Brussels which is intended to move Europe's television world with compulsory supports for the introduction of the intermediate step D2-MAC is self explanatory. He must speak for his channel users who, with few exceptions, transmit all programs using the PAL TV standard. Meyrat does not wish to confirm the announcement from Brussels that the controversial directive will not be issued this year. The pressure of the large corporations on the EC Commission remains consistently strong, but the front of the opponents is no less strong. However, Thomson explains that the company will not force Brussels in a specific direction. However, they would like some kind of clarification concerning the system in order to know what kind of receivers they can build.

Large-Scale Production Trial of European Videophone Slated for 1992

92WS0107A Frankfurt/Main FRANKFURTER
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT
in German 23 Oct 91 p 8

[Article by Professor Karl Tetzner: "ISDN Used as Line Network with Intelligent Data Reduction"]

[Text] Frankfurt—Project Eve-2 (European Videophone Experiment) will commence in January 1992 in Great Britain, the Netherlands, Italy, France, Norway, and also in Germany. In the beginning, up to 50 subscribers are to be recruited in each country and all of them must have an ISDN connection with 64 kilobit/sec.

Videophones with flat, mostly folding screens and built-in small color cameras are among the popular demonstration items at fairs and special exhibits. Year after year, we get to see that which is technically possible but which so far has not been introduced for various reasons. First of all, we run into line problems here. The videophone requires a multiple of the transmission bandwidth of the standard telephone and the terminal unit is horrendously expensive. Both of these facts have so far prevented the videophone from going beyond anything but instructive demonstrations.

Today, conditions for its introduction are possibly more likely to be met. Digital technique is in a position to reduce the bandwidth requirement for data reduction. Of course, a good color television image, in case of digital transmission, requires a line capacity of about 140 megabit/sec, an intelligently made reduction of the data stream down to 2 megabit/sec however will hardly reduce the picture quality in any noticeable fashion.

The transition to only 64 kilobit/sec will probably be accepted by users of big pictures, such as they are

customary when one uses the videophone. There would hardly appear to be any problems as regards the transmission of still pictures. The European ISDN network, which is now being built up, can handle videophone service.

The terminal unit price depends on the production volume, as it always does in electronics. In other words, the videophone would initially be very expensive if the operators—as a rule, the postal administrations—do not provide considerable subsidies. If you ask about the price in the Federal Republic, then you get some rather evasive answers. The situation is different in Great Britain: Mills, the representative of British Telecom, recently said that the terminal unit, generally called Videophone, would initially cost 5,000 Pounds (approximately DM9,000); but over the next five years, that could drop to 300 Pounds (about DM900). That roughly agrees with the statements made by Amstrad and GEC Marconi. Both enterprises are together planning on a relatively simple unit for around 500 Pounds (DM1,500), of course, with a screen of only 7.5 x 10 cm. Videophoning will initially not be cheap otherwise either. Again, we only have statistics from Great Britain: a figure of 400 Pounds has been estimated, although not yet firmed up, as a one-time connection fee for the ISDN plug, plus 300 Pounds annual base fee. On top of that, there are the actual conversation rates that, however, are not steep.

The German Federal Post Office's Telekom, as we said, is still a bit reluctant. To be sure, it does want to introduce Eve-2 before the end of the year, at least for 50 interested parties; but there are as yet no answers regarding purchase or rental of a videophone set. The Post Office wants to deliver the first units. It gets them from three or four German manufacturers, probably from Bosch, Philips, SEL/Alcatel, and Siemens, who have been working intensively on this topic in the past.

Whether the public really wants to have a videophone is something that is still completely up in the air. So far, there has at any rate not been any pressing demand from that quarter, obviously in the awareness that the cost/benefit ratio here is not exactly favorable. This is why it was explained by way of caveat that Eve-2, as indicated by its full name, is just an experiment to alert the public to this new medium to begin with. Ronald Plompen, of the Dutch Postal Administration, put it quite clearly: it does not really matter whether this first attempt is successful right away; instead, the important thing is to sound out the market chances for this item. But none of the openly displayed skepticism can prevent some highly optimistic forecasts. British Telecom credited the European video telephone market with a volume of DM5 billion for 1995.

In Bonn, there is a diagram showing about 22,000 videophone connections in Germany in 1995; in Europe, there are to be just about 100,000 by then. Frost & Sullivan, a market research outfit, even thought that more than \$8 billion worth of videophones could be sold

in the United States in 1995 and that the rates connected for operation would exceed \$2 billion.

It might sound rather odd, but the videophone is older than television. At least, tinkerers, dreamers, and also scientists had some clear ideas about it even before the turn of the century. The Frenchman Robida wrote the following in 1893 in his book entitled "The Twentieth Century": "With the help of the old telegraph, one could understand what somebody wanted to write to one from far away; the telephonoscope, however, makes it possible directly to see and hear the sender." And the Briton Alan Archibald Campbell Swinton in all seriousness asserted in 1912 that the videophone is one of the goals of television as such.

Postal administrations and industry also looked into two-way television conversation, parallel to the development of television. Here we might recall the first really working model of the German Reich Post Office dating back to 1929, of course with rather primitive 30-line images. Just a few years ago, it was on display in the Berlin Postal and Telecommunications Museum, in working order.

The process however was not really introduced until 1936 with the videophone link between Berlin and Leipzig. The partner's 180-line image at any rate showed up in the phone booth on a round picture tube. The electrical-optical scanning of persons, however, was still done by the Nipkow disc. Service soon thereafter was extended to Nuernberg and Munich but it was discontinued at the start of the war. A coaxial cable was used for transmission and the bandwidth was 0.5 MHz. More than 50 years have gone by since then and the dreams of our grandfathers are only now becoming reality.

BLICK DURCH DIE WIRTSCHAFT, 23 October 1991, p 8

Denmark-USSR Fiber-Optic Cable Contract Awarded

92WS0167C Maidenhead TELEFACTS in English
Oct 91 pp 1-2

[Article: "Northern Telecom Subsidiary Wins Major Fiber Optic Cable Contract"]

[Text] A contract worth £40 million, to supply the first international undersea fiber optic cable connection to the USSR, has been awarded by the Danish companies Telecom Denmark Ltd. and GN Great Northern Telegraph Company to STC Submarine Systems plc. STC, the recently acquired U.K. subsidiary of Northern Telecom, specializes in the design, manufacture and supply of underwater telecommunication systems.

The fiber optic cable will support a new 1,260 km multi-media telecommunications link between Denmark and the USSR. The cable, passing underneath the Baltic Sea between Copenhagen and Kingisepp near St. Petersburg (formerly Leningrad), will constitute the first section of the proposed "Trans-Soviet Line" (TSL) cable

system, intended eventually to link east to west across the entire territory of the USSR. Scheduled for completion in February 1993, the new fiber optic connection will support 15,000 circuits for the transmission of high-quality voice, data and video traffic.

Berlin Institute Develops Thin-Film Electroluminescent Displays

92WS0148A Duesseldorf VDI NACHRICHTEN
in German 18 Oct 91 p 25

[Article by Delano L. Klipstein: "Thin Films Show Color TV Pictures"]

[Text]

Flat Panel Screens for High Definition Television Near Reality

Conventional LCD [liquid crystal display] Screens Have Major Disadvantages

Everything appears decided in the area of flat panel screens. The Japanese—primarily Sharp—have conquered the market for flat panel screens to a large extent. Or have they? You might be right if you think of displays using liquid crystal technology as being the only "flat panel screens." However, other technologies are competing for the near term.

Much evidence justifies the assumption that LCD technology will not furnish the large flat panel screens. Current LC displays that use thin-film transistors on the back of the display to drive the pixels [picture elements] support this idea. Conditions such as those known in microelectronics dominate the production of these transistors. Displays of more than about 14 inches along the diagonal have no chance today because of the size limit. There are neither systems nor equipment to make displays having larger dimensions. If such equipment did exist, it would be so expensive that producing the screens would be completely uneconomical.

Besides LC displays, the good, old plasma display and the electroluminescent screen are still in the running. The plasma display is the oldest of all flat displays. The principle of the electroluminescent screen has also been known for many years. In 1936, Georges Destriau discovered an effect that he originally called electrophotoluminescence. This effect is the emission of light from specific compounds (such as zinc sulfide-copper) under the application of an electric field. A screen technology crystallized from this solid-state effect. A small group of companies and institutes continued to work on this technology. In Europe, this was the Central Institute for Electrophysics in Berlin. The EL display exhibits more potential for realizing a high-resolution, large, flat panel screen having the technical quality of a

picture tube than all other technologies. There are several reasons for this. The display is very rugged (it is really solid state). It is simple to manufacture (using robust and mature manufacturing processes). Its picture has high contrast, and it can achieve high resolution.

There is now neither an electroluminescent color screen with a full gray scale nor such a screen having all colors. This is because the technology usually emits light on an on-off basis depending on whether voltage is applied or not. However, from the results available today, expectations are that the still open questions will have answers by the mid-90s. Amplitude modulation has already achieved 16 shades of gray. Work is proceeding now on 64 shades of gray.

Color is somewhat more difficult. The problem is that, until recently, it was impossible to get useable phosphors for all three primary colors. Planar Systems, Inc., in the U.S.A. recently merged with Lohja Oy of Finland. This company already has a partial color EL display. Besides black, this display can represent the two primary colors of red and green and the mixed color of yellow. The company expects to make the jump to blue using thallium fluoride soon. They have already obtained blue-green using SrS:Ce. Planar has also constructed the largest thin-film EL display. It has a picture diagonal of 18 inches and a resolution of 1024 x 768 pixels. Incidentally, this is not a prototype unit. Digital Equipment is installing it in one of their workstations.

Against this background, the work at the Central Institute for Electrophysics in Berlin gains increased importance. The Institute sits on the Hausvogteiplatz in the heart of old Berlin. Via one department, the Institute has applied itself to the development of thin-film electroluminescent displays (TFELD). Describing the structure of such displays is quick. A vapor-deposition or sputter process puts several thin films onto a glass substrate. First, there is a metallic electrode, then an insulator, then a II-VI semiconductor, another insulator and finally another metallic electrode. The total thickness is about 2 μm . The light itself comes from the semiconductor layer. In physical terms, this process uses an avalanche breakdown in the semiconductor and collision excitation of the luminescence centers. Suitable semiconductors are ZnS, SrS, or CaS. The light can escape to the outside from this sandwich structure if one of the two metallic electrodes is transparent. This is the case, for example, with a film of indium-tin oxide.

The design of the accompanying drive system for such displays is simple. A voltage roughly corresponding to the threshold of the avalanche breakdown is applied to all rows of the matrix, one row after another. Also, the correct information voltage is applied to all columns. With a picture period of 20 μs , it is easily possible to drive 1000 lines. Then, the point of intersection receives the brightness information corresponding to the pixel. In doing this, all pixels of one row are driven at once. In this way, there is as much time to drive one single pixel as otherwise for an entire row. Now, the brightness and

drive time are independent of the number of columns. This is the attraction of a flat panel display in the HDTV [high definition television] 16:9 page format. There are no column-dependent drive problems.

The EL displays series-produced in the world until now have been predominantly monochrome (usually yellow). Two approaches are available for full-color RGB [red-green-blue] displays. One method is placing fine phosphor strips in triplets next to one another for each of the primary colors. This is the design used in picture tubes. However, each color then requires its own photolithographic process.

The more intelligent approach would be getting the required colors from white using a subtraction technique. This would reduce the number of lithographic manufacturing steps to only two, thereby increasing production yield. A prerequisite would be the ability to get white with high luminosity. This is because a large percentage of the light is lost in the following color filters using the subtraction method. While layers emitting white exist, they do not have the needed luminosity.

Therefore, expectations are that electroluminescent displays will have little impact on consumer electronics in the near term. Starting in the mid-90s, on the other hand, EL screens may compete with LCDs in the market segment of non-portable expensive screens. This is because of the superior technology of EL screens. For an EL display, the contrast ratio is more than four times greater. The viewing angle is 150° contrasted with 60° for LCDs. The luminance of LCD screens cannot keep pace even now.

Need for Wide-Band Videocommunication, High-Speed Data Transmission Questioned

*92WS0072C Duesseldorf VDI NACHRICHTEN
in German 11 Oct 91 p 24*

[Article by Richard Sietmann: "Video Conferences Do Not Help Wide-Band Technology to Its Breakthrough"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 11 Oct (VDI-N)—There is no great demand for wide-band (BK) communications networks; technical development is moving much faster than the market.

Animated images race through glass fiber lines as easily as telephone conversations do today. However, critics see no great demand for videocommunication and high speed data communication. The strategists of multimedia communications technology, including the network operator DBP Telekom, are still feverishly seeking a market.

Volker Schneider and his colleagues at the Cologne Max-Planck Institute for Social Research searched intensively in five large companies. They did not find a vortex of demand for wide-band communication service. "No

general wide-band infrastructure is required within the next five years"—that is the conclusion of a study which they prepared for the EC Commission.

The companies included Siemens and Grundig, the Dresden Bank and the Commerzbank, as well as Colonia Insurance AG. Although parts of these firms operate worldwide, their need for transnational high-speed data communication and digital video communications is limited. According to the Max-Planck researchers, "Nowhere was a pressing problem or a bottleneck found which would have required a solution based on wide-band networks or applications."

That is true not only for the transnational communications demand. In the domestic market as well, according to the opinion of Rainer Bierhals of the Fraunhofer Institute for Systems Engineering and Innovative Research (ISI), the market potential of business wide-band communications (BK) in fiber optic networks turns out to be "still limited" through the year 2000. Under contract to the Telekom subsidiary Detecon, ISI investigated the prospects for the use of digital BK networks and conducted "explorative case studies" in approximately 300 organizations.

In anticipation of the expected demand, the German Bundespost had already made the effort to offer BK connections to interested customers. Because BK services are not yet standardized, the network set up in the mid-1980's could only be designed with provisional technology. Since 1986, a fiber optic infrastructure for digital transmission at 140 Mbps has been established down to the subscriber level in an initial 30 large cities with the provisional wide-band network VBN.

To shake off the odium of the term "provisional," DBP Telekom is currently expanding the abbreviation VBN as "switching" wide-band network. With the VBN network which went into service on 23 February 1989 and is capable of automatic dialing, Telekom is performing "pioneering work," according to board member Gerd Tenzer. He stresses that this "is not merely network-based technological innovations, but has the primary objective of developing market-appropriate wide-band individual communications services early on through an intensive dialogue with users and testing them in situations where there is real demand."

The "intensive dialogue with users," i.e., marketing, will be necessary. So far, use and numbers of connections have lagged far behind expectations. At the end of 1989, the network designed for 1,000 connections had found only 150 subscribers; currently 274 private and 119 official Telekom connections have been established—including the public video conferencing studios.

According to earlier predictions, by now there should have been a sharp exponential increase in subscribers for individual BK services, but these predictions have not come true. In 1984, ANT anticipated approximately 30,000 BK connections for the beginning of the 1990's, and AEG even 100,000. Currently the ISI considers it

"possible under favorable conditions" that in the year 2000, approximately 0.9 million workers will be using wide-band communications.

"Under favorable conditions" means that fiber optic networks will be available by that time at the beginning of development. On the other hand, there is the case that "the use of fiber optic networks will still be in the experimental stage even in the year 2000." Under this condition—"unlikely, but not impossible" according to wide-band market researcher Bierhals—ISI estimates 100,000 BK users in the year 2000.

Market expert Fritz Brendl, who has been involved with BK problems since the first Bigfon field tests with fiber optic user connections first at PKI and then at Nixdorf, considers Telekom's "restrictive pricing policy" responsible for the lack of demand. "There has been virtually no movement—all interested users baled out primarily because of the price." The current video conference rates on the VBN—reportedly they are now being reviewed—require a setup fee of 12,000 German marks [DM] and DM1,500 monthly for a regular connection, to which the use-based costs must be added. These run between DM1.35 per minute in the inexpensive/local zone and DM1,700 per hour and user with multipoint connections in intercontinental communications.

"The service offers too little for the price," criticizes Brendl, currently manager of Strategic Marketing for Cellular Phones at AEG. "In this line of business marks and pfennigs are important." The costs are too high to make it feasible yet to make the terminal devices available directly in the workplace. The expense for the use of central video conferencing studios acts as a barrier, and the argument of savings from doing away with time-consuming travel has apparently not been persuasive.

However, ISI's Rainer Bierhals thinks it is "not enough" to view the rates as the only problem. According to him, "The entire strategy of introducing the VBN through video conference services was problematic." According to Telekom information, the VBN is used at a rate of 70 percent for this purpose, 20 percent for research, and 10 percent for other tasks, such as high speed data communications. Bierhals does not doubt that video communications will find its mass market when it is available under the conditions of the telephone today, "i.e., widely distributed and inexpensive." However, according to the ISI analyst, "New networks must be introduced for special applications. Once installed video communication is an ideal additional application."

It makes a big difference to the use whether the innovation merely has the character of general office communications with hard to measure uses, or whether it represents a specific solution to a problem with a high use/cost ratio. According to the market researchers from the Max-Planck Institute in Cologne, field tests like the VBN do enable companies to save on "learning costs" which should not be undervalued in the use of BK services. However, they feel that the "great chasm" lies

"between what is technically possible and what is economically reasonable." A more rapid market penetration would be expected, according to the opinion which agrees with the Fraunhofer results, "more from the demonstration of economic-organizational solutions to problems and less from advertising about technical superiority." The Cologne team found the major barriers to be "the costs for terminal devices and software as well as the lack of convincing applications."

The fact that companies would first like to see investments in ISDN systems and terminal devices amortized seems to be an additional reason to hold back on investments in BK systems. "In reality, the two are competing with each other," states Rainer Bierhals. "The innovative leap must first penetrate and be written off financially." The technological push to fiber optics does not automatically lead to the development of demand for BK services, but rather the potential must be "strategically developed."

The formula runs like this: New applications on old networks and old—possibly improved—uses on new networks. In roughly the same way as the fax "added value" to the old telephone network, the narrow-band ISDN could in turn improve the efficiency of fax communications. The "low-cost multi-media world" on the small scale will bring the BK solution into play automatically as soon as the requirement profile demands higher quality from video communication. Bierhals is convinced, "Fiber optics will never arrive if the preparations are not made through ISDN."

Germany: Officials Optimistic About Future of European Telecommunications Market

92WS0086 Duesseldorf VDI NACHRICHTEN
in German 18 Oct 91 p S2

[Article by Susanne Fiederer: "Telecommunications: The Market Continues to Expand—Small Businesses Profit from Service Competition and Lose Due To Liberalization of the Equipment Market" First paragraph is VDI NACHRICHTEN introduction]

[Text] This year's systems, with their extensive product and system lines, clearly show that telecommunications is the industry of the future. Marketing researchers believe that in the next millennium it will replace the automobile industry as the driving force behind German sales.

Helmut Ricke, chairman of the board of directors of Deutsche Bundespost Telekom, is optimistic about the future: "We are hoping to achieve a turnover volume of 80 billion German marks [DM] by the end of the decade." According to the results of the latest market research study, the goal set by the senior Bonn private postal official is well within the realm of possibility.

Eurostrategies estimates that the turnover volume of the world telecommunications market may total \$715 billion by 1993. Europe will account for \$176.6 billion of

this amount, and Germany alone for \$45.7 billion. With this, the turnover volume of the German telekom industry will have nearly doubled in just six years.

The Basel Institute of Economic Forecasting is also optimistic about the future of the telecommunications market. In the EC alone, its share of the gross national product will rise from the current 3 percent to approximately 7 percent. However, this growth spurt has not caught the Japanese napping either. According to the Swiss forecasters, by the year 2000, the Japanese will earn DM52 billion in the world telecommunications market, thereby attaining a market volume comparable to that of the Europeans.

This is no cause for despair. Both the European and the Japanese telecommunications industries will expand—at the expense of the Americans. Although they will remain the world leaders in the telecommunications market, the Americans will lose considerable ground to the newcomers from the Old World. The present surge in the European telecommunications industry is due primarily to the recent cooperation between the industrial giants and the Telekom administration.

In 1987, under the motto "United we are stronger," the European Conference of the Postal and Telecommunications Administration decided to establish the European Telecommunications Standards Institute (ETSI) in Nizza. The first tangible outcome of this initiative was the GSM [Groupe Speciale Mobile] Standard, which is intended to create the European-Wide Radio-Based Telephone System. So far, ETSI has worked out 43 European telecommunications standards. This can only benefit the national telecommunications enterprises, as they will now be able to manufacture equipment for a larger market, namely the European market, without being limited by national standards and thus, to much lower numbers of units.

Until now, market conditions were much less favorable. Prohibitive prices due to low numbers of units prevented the majority of the national telecommunications firms from competing on the international market. In its "Green Book of Telecommunications," the EC Commission estimates the resulting costs of this splintering at DM6 billion to DM10 billion.

Euro-strategists immediately proposed a plan for overcoming this problem. They are placing all their bets on European-wide standards, deregulation (i.e., the opening of the service and equipment market) joint research, and cost-oriented fees. The market researchers claim that Germany and its small and mid-sized businesses will especially benefit from this new orientation. The English market analysis firm Frost & Sullivan predicts that there will be a particularly dramatic increase in the variety of services, by as much as 5-fold.

Nonetheless, due to increasing liberalization, what small and mid-sized firms may gain in the service sector they will lose in the terminal sector. Brussels predicts that the considerable cost advantages enjoyed by Southeast

Asian countries in this sector will enable them to gain ground in the German market.

At present, this is not a significant problem. Before Asian equipment may be operated in Germany, it must be licensed by the Central Telecommunications Licensing Administration (ZZF), which can present difficulties. The German licensing officials require strict adherence to telecommunications engineering regulations. However, with the opening of European borders, there is a good chance that this equipment may gain a foothold in the German market by going through a different European licensing organization.

In any case, as of now, the world telecommunications market is firmly in the hands of a few giants. At the top is the American multicorporate AT&T, followed by Alcatel (France) and Siemens. This trio accounts for 60 percent of the entire world-market turnover. And make no mistake; it has no intention of allowing other suppliers a portion of its market share. Thus SEL, the German subsidiary of Alcatel, is adopting a joint parent-subsidiary strategy to prepare for the European challenges.

Recently in Paris, the firm presented its plan of attack for the coming years. For example, German and French

researchers intend to work together on the up-and-coming broad-band technologies. The firm plans to combine all the telecommunications areas necessary for the operation of the future high-speed networks into one product line, under the name Alcatel 1000. Dr. Manfred Langenbach-Belz, who is responsible for switching systems marketing and product strategies at SEL, is convinced that the firm will profit from this: "We can offer our customers intercoordinated technology in all relevant areas of communications."

Siemens, the German competition, is also excited about the future of telecommunications. "For engineers," says Dr. Hans Baur, "working out the evolution of telecommunications in the 90s will be a fascinating challenge." The Siemens manager expects to see innovations in the fields of mobile radio telephone service and data services in particular.

The objective of telecommunications planners: Just as a person keeps the same first name all his life, in the future he will keep the same telephone number all his life. At this number he can always be reached, whether for business or private purposes, and whether he is on land, at sea, or in the air.

TELECOMMUNICATIONS

Status of Satellite Services Outlined

92WS0208N London 1992 MOBILE & SATELLITE
SINGLE MARKET REVIEW in English Issue 3,
Autumn 91 pp 42-48

[Article by Dermot Nolan: "Development of Satellite Services in Eastern Europe; Entering the Harsh Reality Phase"; first paragraph is MOBILE & SATELLITE SINGLE MARKET REVIEW introduction]

[Text] This paper examines the development of satellite services in the emerging free market economies of central and eastern Europe. Current financial environments for Western investors are highlighted, as well as the necessary steps which remain to be taken before eastern Europe's telecommunications infrastructure can be regenerated.

Today's Eastern European Telecommunications Infrastructure

A Sorry Tale of Neglect

Nineteen eighty-nine may have been the "annus mirabilis" in Central and eastern Europe, but it is only with the free flow of information that the stark nature of the eastern European telecommunications networks has emerged. On average, eastern European telecommunications networks are between 20-25 years behind western Europe.

Present difficulties derive from chronic underinvestment in the telecommunications networks by the previous regimes. This lack of investment in public telecommunications infrastructure was based on political ideology; in Stalinist economics, services were not considered a form of production and consequently their provision was considered merely as a cost to the economy. Additionally, the rights of individuals and enterprises to communicate were restrained to ensure State control of information.

In western Europe, gross annual investment by PTO's [Project Type Organization] is about one third of their annual revenues or just about two-thirds of 1 percent of GDP [Gross Domestic Product]. Equivalent figures for central and eastern Europe are only one-third of a percent of GDP and investment is significantly lower on a per capita basis. CEC [Commission of the European Communities] countries with comparable populations to eastern European countries typically undertake three times the level of investment.

Modern services such as X.25 networks and videotex are virtually non-existent in Hungary, Poland and Romania and are only just emerging in Bulgaria, Czechoslovakia and Yugoslavia.

Few digital exchanges are operative, much of the equipment is virtually obsolete with some exchanges

dating back to pre-revolutionary Russia, and in some cases local exchanges are still operated manually.

Reliable high quality international links are of vital importance to western investors and institutions seeking to do business in central and eastern Europe. The paranoia of the previous regimes has left a legacy of few international links in place, for example Poland only had 400 outgoing and 900 incoming circuits, of dubious reliability, and many dedicated to links with other former Warsaw Pact countries. The most pressing need for Western companies is the rapid establishment of reliable high quality international links, which are now established as a priority for the new governments.

National telephone systems are inadequate. The average national penetration rate of the eastern European region's phone service is about 11 percent, compared with up to 35 percent in other countries with a similar GNP [Gross National Product] per capita. Too many lines have been attached to local exchanges and insufficient long-distance infrastructure has been built, with the result that the systems frequently fail as frustrated callers repeatedly try to call one another.

The most charitable assessment of telecommunications equipment in eastern Europe is to describe it as being antiquated. In the Soviet Union there are some Ericsson exchanges from before the 1917 revolution, and in the five eastern Lander of Germany some 23 percent of the switching equipment dates back to the 1922-1934 period. Many rural areas have to contend with manual exchanges. Facsimile machines, mobile telephones, data transmission and other advanced services are only now beginning, and despite some initial strides it will be years before such services are commonplace.

A critical problem in central and eastern Europe is the lack of free-market experience among middle management, and the problem of attracting, training and retaining the best local technical personnel. Unfortunately, the mindset of the typical eastern European telephone company is even more resistant to consumer pressure than its western counterpart, and until now there has been little incentive to improve efficiency or adopt new ideas.

There are a few bright spots in the current telecommunications systems, with telex remaining the best method for communicating business information. Because of the former Warsaw Pact military interest in satellite communications, some countries such as Czechoslovakia have a high level of technical expertise and are estimated by U.S. specialists to be only five years behind the West in component manufacture. This expertise may prove to be the genesis for local manufacture of TVRO [Television Receive Only] and VSAT [Very Small Aperture Terminal] equipment within a few years.

Current Eastern European Broadcasting Infrastructure

A Similar Tale of Neglect

In the development of satellite services for eastern Europe, one of the immediate growth markets is Direct-to-Home (DTH) television. The opportunities for television services and the manufacture, distribution and sale of satellite television receivers cannot be overlooked. These prospects must be evaluated against the current and rapidly evolving broadcasting infrastructure of eastern Europe.

In most eastern countries there are normally three channels which are terrestrially delivered, two being national channels, and the third with more limited coverage was dedicated to relay Gostelradio 1 for Soviet troops stationed in those countries. Now the third channel is often being developed into a commercial television station, showing segments from Western satellite services.

New media laws are currently being formulated, or in the process of passing through national legislatures, which will lead to the development of the two national channels as public service broadcasters and/or to privatisation of the third channel.

A legacy of overlap from previously forbidden (and much watched) Western terrestrial transmissions, and the former Russian hegemony is the multiplicity of television transmission standards, namely PAL [Phase Alternation Line] and SECAM [Sequenc Electronique Couleur avec Memoire]. The absorption of DFF [Division Final Fade] into the West German broadcasting regime effectively signals the demise of SECAM there. In addition, the growing proliferation of western satellite television is likely to ensure that PAL will emerge as the dominant terrestrial and satellite transmission standard. This has implications for manufacturers of satellite television receivers wishing to develop eastern European markets.

A further development is the likely absorption of OIRT [Organisation Internationale de Radiodiffusion et Television], the eastern Europe broadcasters organisation, into the EBU [European Broadcasting Union] creating a Europe-wide broadcasting organisation, at least for the public service broadcasting sector, by the end of 1993.

Following deregulation and copyright clearance in the various countries, there is now heavy demand in the eastern European countries for western satellite television services, in particular the German and English language services delivered via the SES [European Satellite Company] Astra constellation system. A number of programmes such as ARD [Association of German Public Broadcasting Companies], Sat 1, and RTL [Radio-Television Luxemborg] Plus are using Astra to provide coverage to eastern Europe. Table 1 provides an estimate for the number of satellite dishes in use in eastern Europe.

Table 1: Estimated Satellite Television Penetration

Country	Satellite Dishes
Bulgaria	1,000
Czechoslovakia	36,000
Hungary	50,000
Poland	18,000
Romania	100
USSR	1,500
Yugoslavia	60,000

Sources: USIA (March 1990)

Visitors to Warsaw are likely to see proliferation of Astra dishes (all readily removable for fear of theft, as they are highly prized consumer electronics products) on apartment blocks, as in the UK. In the eastern Laender of Germany, prior to reunification, there was already a huge growth in satellite dishes. For example, one estimate puts the number of dishes as 200,000 in Dresden alone. RTL Plus, the German private television channel part-owned by CLT [Compagnie Luxembourgeoise de Telediffusion], claims it has 35 percent coverage in Saxony, all delivered by satellite. It is believed that the eastern part of Germany (which is partly beyond the range of the main commercial channels) now has more dishes than the whole of the former West Germany. The introduction of the Premier pay-TV film service on Astra has acted as a further stimulus to the dish market in eastern Germany.

The major demand for Western satellite services is undoubtedly driven by the desire for impartial information, the entertainment services provided, and the desire by many eastern Europeans to be integrated with the mainstream media influences of Europe, and to learn English and German. At present it appears that most TVRO's are being imported individually, being purchased in hard currency costing the equivalent of one year's income, or being sold on the black market via smuggling operations. There is evidence of dumping of first generation satellite receivers by several suppliers in eastern European markets. Piracy of western pay-TV services is also growing, with the indigenous development of pirate decoder devices.

Modernising Eastern Europe's Telecommunications Infrastructure

A "fast fix" to upgrade eastern European telecommunications is required. There are technologies which can be established relatively quickly with a minimum of infrastructure investment, which are flexible in configuration, and better equipped to respond to the radical changes taking place in the business environment. In eastern Europe there exists the possibility for these technologies to leap-frog past the development of fixed link networks, which will take many years both to finance and complete their coverage.

The two most appropriate "fast fix" technologies which are being deployed in central and eastern Europe are:

- Mobile Communications,
- Satellite Communications.

Short-term considerations include the immediate need to improve international and business communications (in particular voice telephone), and the requirement to generate revenues.

Critically, building digital overlay networks to provide high-quality service (and simultaneously to unblock national long distance networks), and upgrading international connections via satellite communications means that advanced services for businesses can be provided relatively quickly.

To stimulate market entry by major European and American equipment and service providers, substantial regulatory and structural reforms in the telecommunications and broadcasting sectors are needed. The range of options being considered, or in process of being legislated, is similar to, but often wider in scope, than western Europe. The sense of crisis, economic difficulty, dissatisfaction with the "ancient regime," and openness to new approaches is greater in eastern Europe than in western telecommunications and broadcasting sectors.

Emerging patterns for sector reform include the liberalisation of equipment and service markets, the separation of Post and Telecommunication operations, the development of a legally underpinning regulatory framework, proper frequency planning, and privatisation. In particular for the two vital areas of mobile and satellite communications, joint ventures and complete deregulation are being contemplated.

Satellite Services for Eastern Europe

Eastern Europe is well served by the latest satellite systems such as the Eutelsat II series, DFS Kopernikus and SES Astra. Reception at CCIR [Comite Consultatif International des Radiocommunications] grade 4/5 is achievable in Poland, Czechoslovakia and Hungary via 60 cm to 1.2 m dishes, and over the rest of eastern Europe in dish sizes varying from 1 m through 1.6 m. Good coverage for other types of service is available from other operators such as Intelsat, Inmarsat and PanAmSat.

The arguments for using VSAT's in eastern Europe have been well rehearsed, as in many ways eastern Europe represents the ideal territory for their usage, and the incremental possibilities of VSAT service bypasses the need to raise substantial capital investment unlike fixed link networks. VSAT's are likely to be initially used for data services such as:

- reservation systems,
- transaction processing which is essential for a developing banking system,

- back-up communications,
- document delivery, and
- business television.

A related application which is likely to have a short term window of opportunity is satellite telephony using mobile sets as was recently demonstrated to considerable effect during the Gulf conflict. (It is likely that mobile communications will be the primary route for eastern European countries seeking rapid enhancements of their domestic telephone services, for example, the Westel service in Hungary which is now being rolled out.)

VSAT's will provide the first bearer mechanism for reliable internal and international data networks in eastern Europe. From an investor perspective VSAT technology is attractive because of the incremental character of the typical VSAT network, it is possible with a relatively small investment (compared to a fixed link infrastructure), and modest risk, to bring on-line a national digital overlay network for business-to-business communications in a short timescale.

It is essential for rapid development of overlay networks using VSAT bearers that competition is introduced in satellite services. Varying, but largely chaotic, degrees of deregulation exist in eastern Europe already. For efficient VSAT market stimulus, propositions at least equivalent to, or more liberal than, those contained in the CEC Green Papers on telecommunications and satellite services should be implemented in full by the governments of eastern Europe. A licensing regime similar to that operated by the United States Federal Communications Commission would pave the way for a very fast exploitation of VSAT's to ameliorate the chronic telecommunications problems of eastern Europe. The "Open Sky Policy" of the United States and its commercial ramifications has not gone unnoticed in eastern European countries.

In the broadcasting sector, DTH satellite television is now a reality in eastern Europe. It appears that the SES Astra system is the dominant service delivering German and English language programmes which are understood by eastern Europeans. Recent surveys indicate rapid growth in the sale of DTH satellite receivers.

Opportunities for Service Providers in Eastern Europe

Table 2 shows the opportunities for the main satellite service providers in eastern Europe via Eutelsat, Intelsat, Inmarsat and SES (Societe Europeene des Satellites). The main avenues of opportunity are in the provision of:

- management/technical expertise,
- international (and to a lesser extent national) telephony,
- DTH/TV distribution,
- international/National Data services, and
- land mobile services.

Table 2. Opportunities for Satellite Service Providers in eastern Europe

Satellite Service Provider	Management/ Technical Expertise	International/ National Telephony	International/ National Data Services	DTH TV Distribution	Land Mobiles
Eutelsat	****	****	****	**	***
Intelsat	****	***	***	*	*
Inmarsat	****	**	**	-	***
SES Astra	****	-	-	****	-

Prospects: ****: Excellent; ***: Good; **: Fair; *: Poor

Already eastern European countries are joining Eutelsat (Poland, Romania with the others likely to follow), Intelsat (Poland, Rumania with others likely to apply) and Inmarsat to which the eastern European countries already belonged.

In the case of the private sector satellite television operator SES, it is clear that its pre-eminent role as a provider of DTH television services to western Europe is likely to be repeated in eastern Europe. There are major opportunities for Eutelsat in the field of television distribution (satellite-to-cable networks), SNG and international news exchange.

Opportunities for Equipment Providers in Eastern Europe

In the early phase of infrastructure redevelopment in eastern Europe, there are likely to be three categories of satellite communications equipment which will have strong growth prospects:

- turnkey VSAT systems,
- Eutelsat/Intelsat hub Earth stations, and
- TVRO's/satellite receivers.

Prospects for turnkey VSAT systems are excellent provided that a favourable regulatory regime is defined in eastern Europe, realistic cost based tariffs are introduced for provision of network service, and the relaxation of Cocom [Coordinating Committee for Multilateral Export Controls] regulations is extended to the more sophisticated types of VSAT network, in particular the software components and computer hardware. Careful re-export controls are likely to be required for this category of system, (see Table 3 [omitted]).

In Poland Vestel B.V. which is a VSAT service provider has connected up ABB [Asea Brown Boveri] factories in Elblag and Wroclaw to the Swedish head office affording reliable voice, fax and data communications over the VSAT network. It is believed that about 20 companies are interested in operating VSAT networks in Poland, requesting a total of 2,000 VSAT installations.

Equipment providers are installing major satellite ground stations, primarily for international telephony and data applications in eastern European countries such as Poland and Romania. The World Bank recently approved a \$120 million loan to improve overall telecommunications in Poland, which will partly be used to finance the construction of Poland's new Eutelsat earth station located at Psary, near Warsaw. This station is expected to come onstream in mid-1992. Similarly, Romania is building a \$3 million Eutelsat earth station at Cheia, near Bucharest for international telephony traffic.

Major facilities of this nature are likely to be few in number as a single facility will probably cater for the initial traffic flows in eastern European countries, at least for the next few years. Additional demand is likely to be catered for by "hub" earth stations located elsewhere in Europe. The growth of VSAT's, now highly likely in several countries such as Hungary and Poland, will ensure demand for dedicated hub earth stations.

Demand for TVRO's/satellite television receivers is increasingly strong and this is an area where there are few regulatory obstacles apart from copyright payment to rights holders and satellite television programmers. From June 1990 Cocom restrictions on this technology were abolished. Today satellite television receivers are being manufactured in eastern Europe for domestic markets, and in due course it is possible to envisage satellite television receivers being manufactured in eastern Europe for western European markets. This development would take account of the high level of technical expertise, lower unit labour costs, proximity to western European markets and the strong indigenous expertise in satellite communications technology.

Paying for Equipment and Services—The Need for Developed Financial Services

Once equipment and service providers have converted opportunities into contracts there is a requirement to identify suitable vehicles for payment. Difficulties in establishing business enterprises or joint ventures, or in repatriating profits in convertible currency constitute important barriers to market entry: medium-sized suppliers like VSAT vendors would benefit in particular from early moves towards currency convertibility. In some countries convertibility is up to five years away, although in Poland the Zloty is convertible.

As is well documented elsewhere there is a dire shortage of convertible currency. Furthermore a much higher proportion of investment will need to be paid for in convertible currency than was previously the case. Studies have shown that in the past over 90 percent of eastern European telecommunications investment was denominated in domestic currency, with about half going for construction, and civil works.

In the future if domestic manufacturers fail to modernise, reduce costs and enhance quality the governments of eastern Europe will have to spend a high proportion of hard currency or else curtail telecommunications reconstruction. Assessments have shown that the proportion of equipment purchased for hard currency will rise to 40-50 percent in the next five years, and then hover around the 30 percent mark for the remainder of the decade.

This will impose a severe burden on those countries with large hard-currency debt burdens (Poland, USSR, Yugoslavia). It is also true that those eastern European countries with low debt (Bulgaria, CSFR, Hungary) have limited ability to earn hard currency and many contingent demands on new hard currency revenues. In the period of the "ancient regime," the government financed any authorised expansion. The strict financial restructuring programmes in place to reduce the debt burden and, inflation will place severe constraints on government-sponsored funding. A natural recourse in other middle income countries with a capitalist economic outlook would be to capital markets, but in eastern Europe this option is only just becoming available. Banks and other financial institutions, such as stocks and bonds are all in a nascent stage of development in eastern Europe. Although Stock Exchanges have been opened in Hungary and Poland, they are still illiquid.

There are some striking differences between eastern Europe and other middle income countries. Some productive structures (percentage of GNP derived from industrial activity, the education level of the work force) are closer to the norms of industrialised countries than to typical middle income countries. Others, mainly in the domain of commercial activity and services, like financial services, accounting, retail distribution, commerce and marketing are highly underdeveloped. The problem is compounded because of the lack of free market experience at all levels of society—the concept of the profit/loss idea is novel—and buyers have no experience of free market purchasing because of the central planning organisations which held sway in the past.

As mentioned above, it is a feature of all eastern European countries that they have a relatively well-educated population and large numbers of telecommunications engineers and experts, but there is a major shortage of skills required in the new free market conditions. There is a critical shortage of personnel equipped with normal commercial disciplines like marketing, accounting, cost control, financial analysis, MIS [Management Information Science] specialists in monitoring and analysing economic performance of telecommunications entities; and on the technical front there are severe shortages of personnel qualified in digital and computer techniques.

Mirroring the western experience it is clear that recruitment and retention of high quality staff with the appropriate skills will be a key human resource issue in eastern Europe over the next 10 years. A further complication with the opening of borders is that there is a partial

exodus of quality technical personnel to the West, lured by better pay and more prestigious employment, and easy access to work permits.

The Cocom Obstacle Course

The Coordinating Committee for Multilateral Export Controls (Cocom) which controlled the export of technology to the former Warsaw Pact countries liberalised sales of technology across many categories in June 1990, in particular civil satellite communications technology. The important innovation in this liberalisation is that special status has been accorded to three countries—Hungary, Poland and Czechoslovakia—now deemed to be less of a strategic threat. To qualify for special status these countries are required to set up systems and controls to prevent Western technology being re-exported to the Soviet Union and other eastern European countries, including curbs on the passage of advanced technology information through intelligence.

For satellite communications the following sectors are now decontrolled:

- satellite earth stations for civil communications, direct broadcasting, or meteorology, and
- satellite television receiver systems.

In addition Poland, Czechoslovakia and Hungary are licensed for digital radio-relay equipment operating at bit rates up to 156 mbits per second, and for technology in the production of permitted radio relay equipment.

Cocom restrictions are now a bending barrier to importation of products and technology to the East, but the approvals procedures remain a slow and bureaucratic business slowing down and hindering the ability to do business. There is a suspicion amongst certain European suppliers that operation of the Cocom rules may be favouring U.S. suppliers in new dealings with the East. According to CEC it appears that the ability of certain western companies to obtain waivers of the Cocom restrictions is already influencing the purchasing decisions of telecommunications administrations in central and eastern Europe.

A further consideration is that some VSAT technology could be sensitive, because state of the art software-controlled VSAT systems could form the backbone for a highly advanced digital communications network, with strategic implications.

In future, the need to counterbalance the decline in Cocom's role and strategic controls, with the need to maintain or enhance controls on sensitive technology, such as advanced telecommunications, for non-proliferation reasons, will produce major issues of policy and practicality. An added complication, is that the Soviet Union and eastern Europe, which are proscribed for the purposes of Cocom, are increasingly developing a common approach to the West on proliferation issues.

As recent events graphically illustrated, export control policy is being confronted by a major new challenge, which differs in character and substance from the strategic threat. If proliferation is to be prevented, or made too expensive, it is likely that suppliers of technology will be required to improve the effectiveness of their controls, and in particular to operate within a multilateral framework.

New regulations superseding Cocom are likely to be agreed, which will have as essential elements:

- an agreed list of sensitive technology, regularly updated and having industry approval,
- a unified approach to export controls,
- procedures for dealing with procurement activities, and
- the creation of level playing field regimes in the exportation of technology, and the streamlining of licence approvals procedures.

At the time of writing, further relaxation in Cocom regulations is anticipated for eastern Europe, and several countries may eventually be removed completely from Cocom control.

Current Financial Structure in Eastern Europe

A Moving Target

The developments in central and eastern Europe show that satellite telecommunications infrastructure investment will be inward, because domestic revenues and resources are currently insufficient, and, furthermore, governments or the telecommunications administrations of eastern Europe will be unable to borrow sufficient funds on international capital markets. Free markets and prices are required for investors to earn a commercial rate of return (at least 25 percent internally), which has radical implications for the unrealistic price controls now in place.

To accelerate the pace of investment, certain obstacles to business in the current financial structures of eastern Europe, must be removed. These are controls on the flow of capital and profits, the vexed question of property ownership, legal barriers and other obstacles such as perceived political instability.

Table 4 shows the current financial environment for Western investors in central and eastern European countries, covering the main areas of concern such as:

- foreign participation stakes,
- taxes,
- profit repatriation, and
- local taxes.

Table 4. The Financial Environment for Western Investors

Country	Foreign Participation	Tax	Profit Repatriation	Withholding Tax
Bulgaria	Up to 100%	40%	Yes	15%
CSFR	Majority shareholders	10%	Subject to funds	25%
Hungary	< 49% no permit; > 49% permit required	40-50% (5 year tax holiday)	Yes	0%
Poland	Up to 100%; Minimum 20%	40% (3 year tax holiday)	Restrictions on foreign currency	30%
Romania	Up to 100%	30%	Yes	10%
Yugoslavia	Up to 100%; Not telecommunications	10%	Yes	0%

Source: OECD (adapted)

At the time of writing, this table is a moving target as regulations governing foreign enterprises are rapidly being altered under pressure from foreign investors, such as the recent relaxations on joint venture legislation in Romania. Despite advances in the local financial and legislative framework, it remains probable that eastern European governments will be keen to retain a larger slice of profits generated from local telecommunications operations, in order to build a general nationwide public network and discharge public service functions. This conflicts directly with requirements for a greater commercial approach. In particular the construction of new national public networks requires the cross-financing of services from others which will become more profitable at an earlier stage like mobile communications and satellite communications, because of their lower infrastructure development expenditure.

A further complication, is that because of the perceived instability and low levels of national issues, new investors often want guarantees which are counter to the basic premises of competitive entry. Recent experience has demonstrated that new players (including western investors) often require:

- exclusive licences,
- tax holidays,
- minimal regulation of tariffs, service and performance.

Following on from this, there is a requirement for legal and regulatory frameworks to be instituted, which enshrine the "rules of the game," covering areas such as financing arrangements, licensing policy, enforcement, and interconnection arrangements.

New telecommunications laws which detail these arrangements currently exist only in embryonic form, as they do not define specific regulatory mechanisms or

detailed policies. Until these laws are enacted, it is likely that many Western investors will remain on the sidelines because of the inherent financial risks.

Indeed, some of the major players are carefully scrutinising the terms and conditions on offer by the government of each country. In 1989, and early 1990, it appeared that the opportunity to assist central and eastern European countries to leap-frog the incumbent technologies was a real prospect, but unfortunately it now appears that many countries are seeking to emulate the monopolist and dirigiste policies practised by several European PTT [Postal, Telegraph, and Telephone Administration] administrations. As graphically demonstrated in Europe, this has hamstrung the development of new and innovative services in the European Community. In eastern Europe the consequence could be that the development of a modern telecommunications infrastructure is severely retarded.

Upon close examination of the regulatory policies which are emerging, it is clear that anti-competitive strands are unfortunately beginning to materialise. While 51 percent ownership of telecommunications services by national organisations is acceptable, the requirement sometimes imposed is that the foreign investor must provide all the capital for the project—which is anathema to investors. For the investor to get a satisfactory return on his 49 percent stake, such operations have to be twice as profitable as a 100 percent foreign owned company. Therefore, the risk to the investor is doubled, and consequently the likelihood of the project materialising decreases significantly.

A result of this situation is that investors faced with this type of financial regime will inevitably select "cream-skimming" telecommunications projects, and the fundamental investment in national networks so desperately needed will not take place.

Alternative Methods of Payment for Equipment and Services

Equipment and service providers are examining alternative methods of payment for equipment and services, in particular:

- barter,
- joint ventures,
- local licensing arrangements, and
- take-overs.

Barter is a well-established vehicle for payment. It had been widely developed in eastern Europe and the Soviet Union prior to the changes ushered in by the events of 1989. The advantages and disadvantages of barter are well documented elsewhere. With the current economic crisis caused by the world recession, the requirement to pay for [words illegible] in hard currency, and industrial restructuring, barter is again in favour, particularly between the countries of eastern Europe and the USSR.

The favoured route for inward investment by the eastern European countries is joint ventures, which from their perspective facilitate:

- transfer of expertise to the eastern European partner in the venture,
- technology transfer, and
- acquisition of western-style management skills.

As noted above, in some countries restrictive legislation remains on profit repatriation and finance sourcing via the joint venture vehicle, which is a significant barrier to formation of joint ventures. It is clear from the early experiences of the trail blazers that the successful company is the one prepared to invest in local manufacture and to build up local relationships. Adopting this strategy avoids technology and commercial imperialism "carpetbagging," and enables the supplier to gain access to local technical skills and generates goodwill for future business relationships.

From the perspective of the western partner in the joint venture the advantages are:

- local knowledge and conformance to local business culture,
- low income levels,
- high education levels,
- transfer of employees to the joint venture.

The disadvantages are:

- no mindset in the indigenous workforce for free markets,
- capital and future of the partner,
- working morale,
- salary competition to the local partner.

Another avenue for inward investment, harnessing the high quality technical expertise and good software skills found in the East, is the use of local licensing agreements.

In the strategic sectors of telecommunications and broadcasting, complete takeovers of local entities by foreign companies are unsympathetically viewed by the current governments because of the loss of control involved.

Closing the Gap With Western Europe

Regulatory Prerequisites

To develop eastern European telecommunications almost to the point of parity with some western European countries is a prerequisite for economic growth and, alas, a mammoth task. It has been estimated by the World Bank that \$60 billion will be required over the next 10 to 12 years to accomplish this. The gap between

what eastern Europe can generate via GNP funded development and the figure mentioned is on the order of \$6 billion per annum, and so foreign investment is a *sine qua non* to achieve this objective. As mentioned before, foreign investors are only likely to take the plunge if the investment conditions and the regulatory infrastructure are opportune. At present it is a buyers market, in that the operators can pick and choose in which country or countries they would like to invest. For eastern Europe the implications are clear: to attract the major players the telecommunications tariffs, services and regulatory environments must be liberalised to the point where parity is achieved not with the dirigiste approach common in nearby parts of Europe, but with the most liberal telecommunications markets such as the United States, United Kingdom and Hong Kong. Operational experience has demonstrated that the result of competition is a much wider choice of services and much lower prices for these services. The deployment of the competition tool is a powerful vehicle to ensure universality and diversity of telephony. An often cited example is the fact that the rate at which mobile cellular services have grown in the United Kingdom is eight times faster than experienced in France and Germany. In the broadcasting sphere there are over 1.5 million DTH satellite receivers in use in the UK, compared to 30,000 in France. The lessons of competition are clear.

The climate of telecommunications and broadcasting liberalisation in eastern Europe is necessary to:

- facilitate rapid growth of the national economies through regeneration of the telecommunications infrastructure,

- provide the right conditions to attract the major western players (who are in the enviable position of enjoying a buyers market) to make the necessary investments in provision of equipment, services and know-how,

- stimulate demand for services thereby generating critically important revenues, and,

- create a situation where VSAT's can be effectively exploited to rapidly provide a digital overlay network for data (and perhaps voice telephony) in each country.

Root and branch exploitation of VSAT services throughout eastern Europe for business applications could embarrass the more monopolist western European PTT's to liberalise the use of VSAT services. This could be the vehicle for an "Open Sky" policy to be introduced.

The peculiar strategic imperatives which central and eastern Europe currently face demand a radical approach to restructuring telecommunications and broadcasting. This can only be engineered by far-reaching liberalisation, covering operational and regulatory functions, and comprehensive exploitation of modern technologies such as mobile communications VSAT's and DTH satellite television, unfettered by regulatory constraints which have dogged the widespread use of satellite communications for business and leisure purposes in western Europe until recently. Without liberalisation and openness to competition, eastern Europe will not emerge from its telecommunications and broadcasting backwater.