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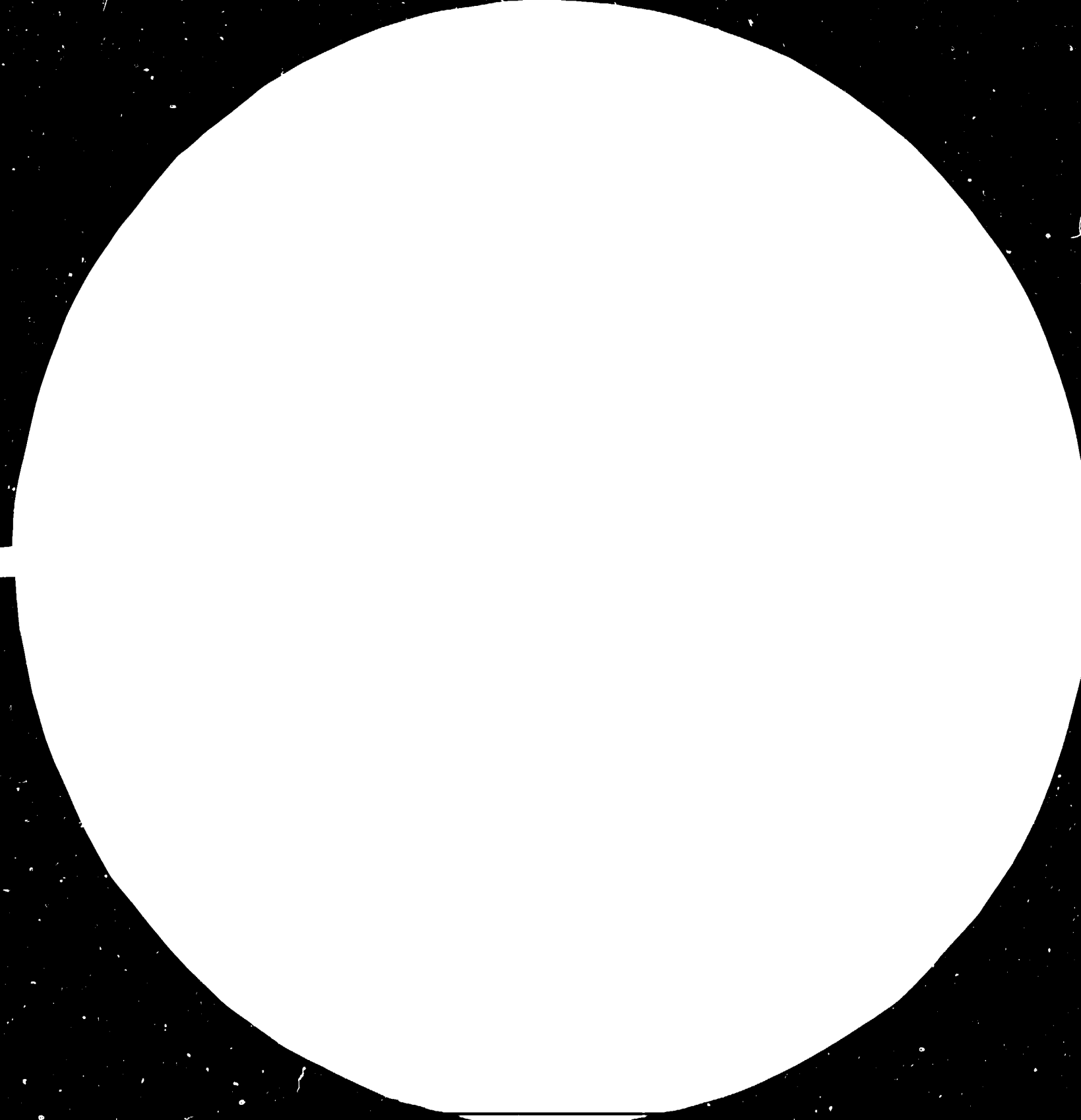
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-
1963-A
STANDARD REFERENCE MATERIAL NO. 1010
ANSI Z39.18-1963 TEST CHART #1010

MICROELECTRONICS MONITOR.

12990

Issue Number 7

July-September 1983

Dear Reader,

As you will have noticed from reports on UNIDO's activities in the last few issues, a number of meetings have been held during the last year or so on the subject of technological advances, in which microelectronics figured prominently. Recommendations made by these meetings reiterated the need for UNIDO to assist developing countries, and also take the initiative for regional and international action, in regard to chip design, development of locally suited applications, promotion of software etc.

We believe that the starting point for such activities would be to ascertain more fully existing work with regard to microelectronics as prevailing in developing countries, and also their needs. It is also thought important to identify groups in each country which could become nodal points for co-operation. In order to help us obtain preliminary information, we have drawn up a questionnaire which you will find attached to this issue. If you are yourself engaged in work in the field of microelectronics or happen to know of groups working in your country, we would appreciate your assistance in having the questionnaire filled and returned to the Technology Programme of UNIDO.

We also plan to start a new section on "Assistance required: Assistance available" which will contain details on industrial opportunities or specific information required by entrepreneurs in developing countries as well as those offered from industrial firms or organizations throughout the world. As this will essentially be a "readers' corner" and will depend on their interest, we are inviting contributions and hope to be able to publish some already in our next issue.

G.S. Gouri
Director

Division for Industrial Studies

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NEWS AND EVENTS

UNIDO sponsors workshop on response of developing countries to technological advances

workshop on institutional and structural responses of developing countries to technological advances was held in Dubrovnik, Yugoslavia from 31 May to 4 June 1983. It was organized by UNIDO in co-operation with the Science and Technology Policy Research Centre, Mihailo Pupin institute, Belgrade, Yugoslavia. The workshop reviewed the institutional trends in developed and developing countries in the transfer, development and application of technological advances in specific fields such as microelectronics; genetic engineering and biotechnology; new materials and technology; petrochemicals; energy from biomass and solar photovoltaic cells.

The workshop was designed as a follow-up to the Forum on Technological Advances and Development, held in Tbilisi, 12-16 April 1983 (vide issue No. 6) and also to provide further inputs for eventual consideration by UNIDO IV.

Recommendations made by the workshop with regard to microelectronics as contained in the report of the meeting (ID/WG.401/7, paras. 40-46) are reproduced below:

"Even in the less developed of the developing countries, there would be extensive use of microelectronics-based equipment for the power and communication industry and for many other industrial and service activities. This called for a technical capacity for repair, maintenance and, more importantly, for appropriate integration of the equipment used. Thus, even in such countries, a programme should be set up to enhance its microelectronic capabilities through increased awareness of key people, training of personnel in handling electronic equipment and in software, establishment of minimum infrastructure for testing, repair and maintenance.

"In several developing countries there were already some groups working in the design of electronic equipment, many of them operating within a very limited infrastructure and with poor support. In general, these groups suffered from lack of components, problems in designing and manufacturing good quality printed circuits and insufficient understanding of the engineering of the systems where a microelectronic application would be carried out. In these cases, it was important to heighten the awareness of decision makers of the big potential of these groups, with better engineering focused on the applications with the necessary support in components, printed circuits, mechanical design, capacity to transfer results obtained in industry etc. It was at that stage that a "centre" devoted to providing such electronic infrastructure support was justified. Furthermore, the workshop recommended that UNIDO undertake a study to analyze in detail the infrastructure needed or the establishment and operation of this type of centre.

"In some developing countries there were already local industries successfully manufacturing microelectronic-based equipment designed locally. In such cases, the potential already existed for the design of custom or semi-custom micro-circuits that could be manufactured locally or abroad. The support required by industries at this stage was mainly in the area of computer-aided design and, where relevant, in the different aspects of micro-circuits manufacturing. The level of support that local governments and industries would give to the development of the technical infrastructure required at this stage, would depend on the possibilities of the market, the level of sophistication of the applications and the availability of complementing facilities from abroad.

"It was recognized that the development of the technical capacity required to support the microelectronics industry as suggested above was costly (in order of tens of millions of dollars) and that it would take at least 3 to 5 years to train the initial personnel for many of the technical support activities suggested.

"The workshop emphasized that the above suggestions should be complemented by a national programme for microelectronics development in the country following the recommendations of previous UNIDO meetings, namely public awareness campaigns; concentrated programmes for education and training; support for the manufacture of electronic components and the application of microelectronics in production and services; public procurement policies; R+D subsidies; research contracts; low-interest loans; investment grants etc. However, without careful attention to the technical details, all such measures would be ineffective.

1/ 'Some Considerations about a Practical Approach to the Development of Technical Infrastructure for Microelectronics' by Guillermo Fernandez de la Garza, ID/WG.401/6.

"With respect to the application of microelectronics to rural problems and their integration with traditional technologies, the workshop noted suggestions for such integration and feasibility in some cases. While acknowledging the decisive importance of that type of application of microelectronics, it was felt that the available information on that aspect was scarce and suggested that UNIDO commission a study to analyze specific cases of success or failure and provide reliable guidelines for ensuring success in the application of microelectronics in rural areas or in merging them with traditional technologies.

"In order to improve communications and possibilities of collaboration among developing countries, it was suggested that the "Microelectronics Monitor" published by UNIDO place particular emphasis on reporting the activities and results of groups working in developing countries and also of co-operative activities among them."

Computer model for feasibility analysis and reporting developed by UNIDO

UNIDO has developed a unique computer software programme to work in conjunction with its popular Manual for the preparation of industrial feasibility studies (ID/206). The programme - the computer model for feasibility analysis and reporting (COMFAR) - was developed with the assistance of a grant from the Austrian Federal Chancellery. The application of an electronic data processing (EDP) programme in conjunction with the approach taken in the Manual makes it easier and faster to handle the large number of computations required when working out various alternatives during preparation of pre-investment studies (opportunity, pre-feasibility and feasibility). COMFAR is also a further step towards standardization of pre-investment studies, strongly recommended by the First Consultation on Industrial Financing, held at Madrid in October 1982. In addition to pre-investment studies, the programme can be used during the negotiation of contracts or joint ventures and, in the course of investment follow-up, where the actual implementation costs can be immediately compared with those projected at the feasibility-study stage.

The UNIDO-developed software is thus a very suitable tool for experts, consultants, consulting firms and UNIDO staff as well as international organizations and national institutions that are active in preparing, evaluating and financing industrial investment projects. For example, a government official in, say, Bolivia or Thailand can punch in data on the various factors involved in planning a new factory. In minutes the computer can generate tables on initial and current investment, sales production programme, production cost tables, cash-flow tables for financial planning, net income statements, projected balance sheets and discounted cash-flow and financial ratios. Because the COMFAR system has been designed to run on portable personal computers, consultants carrying out pre-investment studies or contract negotiations on behalf of UNIDO will be able to make all required computations in the field.

Following a demonstration of COMFAR earlier this year, the United Nations Development Programme (UNDP) expressed interest in possibly installing the system at its New York headquarters and at some of its larger field offices. Other United Nations agencies have requested COMFAR, and the Economic Development Institute of the World Bank plans to use the system in its industrial and development banking seminars at Washington, D.C. Similarly, a number of countries with centrally planned economies have also expressed interest in the software for their pre-investment work.

The cost of acquiring the COMFAR software ranges between \$US 9,500 and \$US 15,000. This includes a user's manual explaining the application of the programme training of the staff and the eventual provision of an updated programme. Versions are also planned for 1984 in French and Spanish. The hardware, which consists of an Apple III microcomputer using PASCAL language, a video-display monitor, two diskette drives (for floppy discs), a "Winchester" disc, a dot-matrix printer including graphics and a daisy-wheel printer would cost approximately \$US 8,000. While the system at present works only with the Apple III, it is planned to make it available on other personal computers, beginning with IBM in 1984.

Requests for further information are invited from potential users who are financially able to acquire the system.

US National Research Council to look into the application of microcomputers in developing countries

The Board on Science and Technology for International Development (BOSTID) of the US National Research Council (NRC), with AID funding, will undertake an examination of a set of major issues associated with the rational dissemination of microcomputer technology in developing countries. A series of workshops and study reports over a three-year period is therefore proposed. This approach is considered appropriate because the technology (both

hardware and software) is undergoing continued rapid development resulting in lower costs and greater computing power. A static view of the opportunities and limitations may be quickly outdated. In addition, available information from field projects, where microcomputers are currently being used on a demonstration basis, will not become available for some time. It therefore becomes important to maintain the flexible approach implied in a series of related studies.

The role of the donor community in guiding the dissemination of this powerful new technology has not been clearly defined. Many of the issues will have to be dealt with over the next three years. A series of studies will give BOSTID the flexibility to respond quickly as the technology develops and as problem areas manifest themselves.

A series of four workshops will be undertaken as the basis for the study reports. The topics chosen cannot comprehensively cover all aspects of microcomputer technology and its introduction in developing countries. The four topics as a whole will, however, cover aspects of special importance to developing country governments and donor agencies. They are as follows:

1. The use of the microcomputer for management and science applications in developing countries

This initial workshop and report will focus on the two principal uses of microcomputers, those of management and administration, and those of science and technology.

For management applications, participants will focus on project management techniques such as budgeting, scheduling, Program Evaluation and Review Techniques (PERT), inventory control, forecasting, general accounting, and data base management and networking using the microcomputer and commercial software. The presumed users would be project management groups, such as developing country ministries, donor organizations and contractors, as well as small entrepreneurs.

On the scientific aspects, the workshop and report will describe the variety of applications of microcomputers in science and engineering for agriculture, health, and energy. Applications might range from university laboratory experimentation to system design and engineering. Other uses include structural design for buildings, transportation modelling, facility siting, and energy modelling.

Case studies describing existing uses in both developed countries and LDCs will be presented. The encouragement of microcomputer use in the management and scientific sectors should establish and consolidate local capacity to carry out these tasks with a minimum of outside help.

2. The potential of microcomputers and expert systems by paraprofessionals in developing countries

The use of expert microcomputer systems for rural health programmes for diagnosis, record keeping, and rapid epidemiological assessment, for example, could benefit rural people significantly. Other real-time uses include agricultural applications such as water quality sampling, soil sampling, and irrigation scheduling. This report and workshop will review case studies of such uses in developing countries, explore opportunities for upgrading rural systems of health care, agriculture, and other fields by use of these new technologies by paraprofessionals, and attempt to recommend new applications as well.

3. The use of microcomputers for education and training in developing countries

A variety of educational needs have been identified which could benefit by application of microcomputers and associated graphic systems. This workshop and study will focus on the opportunities of the technology as a training tool throughout the educational chain, from primary school to university and vocational training. Also included will be literacy training, health care training, and simulation. In-depth case studies will be carried out, examining actual training uses with relevance to developing countries.

4. The institutional policy environment, private and public, surrounding the use of microcomputers in developing countries

The final workshop and report will summarize findings of the previous three activities by focusing on the policy options a government needs to consider regarding the widespread introduction of microcomputers. This will include an examination of the impact on user organizations and address questions of man-machine interaction, use of the main frame

computers versus microcomputers, configuration of an organizational structure and software support services, dispersed use versus central use, equipment service, technical standards, purchasing policies, use by the small entrepreneur, and credit mechanisms necessary to implement a national programme. Policies on communication between local databases and international networks, and associated issues, such as transborder data flow, will also be reviewed.

These workshop studies will be distributed through the normal channels and convey the information in a clear and simple manner intelligible to S&T policy makers as well as to those specifically trained in electronic information science. In keeping with normal practice, these reports will include extensive references and list individuals and organizations that can serve as resources to developing countries in this technological area.

"DIDACTA 84"

"Man between communication and microelectronics" will be the title of a five day conference to be held in connexion with the 20th International Educational Materials Fair, from 20-24 March 1984 in Basel, Switzerland. The conference will highlight the didactic and pedagogical consequences of the implications of microelectronics on the work place and the work media. Lectures, group and plenary discussions will centre on computerized data retrieval and data protection; on communications research and developments in robotics. Further information can be obtained from: Sekretariat DIDACTA 84, Postfach, CH-4021 Basel, Switzerland, telex 62 685 fairs ch.

The following information has been excerpted from the sources indicated.

NEW DEVELOPMENTS

Bipolar technology versus mos technology*

A battle that most people thought had been fought and decided in the 1970s is flaring up again. It has to do with which processing technology will dominate chip-making. On the one side stand the backers of bipolar technology - in particular, Britain's Ferranti. On the other, backing mos technology, stands practically everybody else.

To understand, it is necessary to go back to the basics of turning silicon into chips. In its natural state, silicon does not readily conduct electricity. Each silicon atom has four electrons in its outermost shell and, in a solid crystal, the atoms are arranged symmetrically so that each atom is surrounded by a stable configuration of eight shared electrons. To turn silicon into a good semiconductor, you have to "dope" it - to introduce another element into the crystal lattice that upsets this stable configuration. Replace a few atoms of silicon with, say, ones of phosphorus (each of which is surrounded by five electrons), and you create what is known as an n-type semiconductor. Replacing a silicon atom with a phosphorous one introduces an "extra" electron - one which has no role to play in bonding the lattice together and which can therefore be mobilised by applying a small voltage across the crystal. Alternatively, you can dope your silicon with, say, boron to create a p-type semiconductor. Because a boron atom has only three electrons instead of the four of a silicon atom, the result of this substitution is an electron deficiency, a positively charged "hole" in the lattice. If you apply a voltage to the crystal, an electron from an adjacent atom in the lattice will move to fill the hole - leaving another hole behind it to be filled in turn. The process is then repeated so that, in effect, the hole is passed along the lattice from atom to atom. Electronics engineers say that current in an n-type semiconductor is carried by negatively charged electrons while that in a p-type semiconductor is carried by positively charged holes.

Creating an integrated circuit is a matter of how you manipulate n-type and p-type regions on a chip, and there are only two basic choices. Bipolar technology was the first to be developed, having been invented by America's Bell Labs back in the 1940s. As its name implies, bipolar technology capitalises on the different charge - or polarity - characteristics of n-type and p-type semiconductors: both electrons and "holes" participate in generating currents in any one device.

* See also article on page 16 in issue No. 3.

The second technology, which came into use only at the end of the 1960s, is mos (short for metal-oxide-semiconductor) technology. Any one device on a mos-chip relies on only one type of current carrier - electrons or holes - rather than both. For instance, n-mos devices, used in microprocessor and memory chips, rely on electron carriers. N-mos and p-mos devices can complement each other nicely: the process which puts both types of semiconductor devices on to one chip is known as c-mos technology.

Bipolar chips have one intrinsic advantage. They are fast. They have intrinsic disadvantages as well. They are power-hungry. Also, bipolar technology tends to be wasteful of space: it is hard to cram a lot of different bipolar devices on to a single chip. Mos chips, by contrast, are relatively slow. But they have two advantages. C-mos chips, in particular, require much less power - making them ideal for battery-operated devices. More important, it is easier to cram a lot of separate devices on to a mos-chip. The main reason is that, whereas individual bipolar devices on a chip have to be isolated in specially doped "islands" of silicon, individual mos devices do not. So, in the 1970s, when the accent was on cramming more and more components on to standard chips and when the market for battery-operated devices was taking off, mos technology was widely adopted. Bipolar technology looked like being confined to the production of custom chips for high-speed applications. Ferranti took a different view. Picking up an idea developed by Bell Labs but discarded by it in the early 1970s, Ferranti doggedly developed an advanced form of bipolar technology known as CDI (short for collector diffusion isolation) as a basic process.

Could CDI bring bipolar technology back into main-stream chip manufacture? Admirers of CDI argue that it could - for three reasons. First, given mass production runs, CDI chips ought to be cheaper to make. C-mos remains a relatively complicated process, using 12 main manufacturing or masking stages, compared with only six for CDI. And fewer steps should mean fewer faults and so higher yields for the CDI process.

Second, CDI chips are not so power-hungry as conventional bipolar devices. Third, in any case, the market for chips is changing - in particular, the market for chips for desk-top computers. Whereas yesterday's machines relied on stringing together standard chips, tomorrow's will rely on fewer, bigger, customised chips to get speed and performance.

If bipolar technology has improved over the years, so has mos technology. The speed edge of bipolar chips has been eroded by the ability to shrink c-mos transistors and to make them in very thin films of silicon laid on top of electrical insulators. Britain's GEC, for instance, has been depositing silicon on industrial sapphire. Immos seems to have cornered the high-speed, medium-density memory chip market with its 16,000-bit n-mos ram and has already put its "fifth-generation" computer processing chip (the transputer) into c-mos. It would have been awkward to design either of these as bipolar chips.

Even in gate arrays, mos technology is fighting back hard. Japan's Toshiba is putting the finishing touches to an array of 20,000 gates in c-mos, which could be highly competitive with Ferranti's CDI gate arrays. Of course, it may be that mos and bipolar technology will one day join hands. In theory, it should be possible to marry bipolar and mos devices on to one chip. But nobody has yet licked the practical problems. (The Economist, 2 July 1983.)

The mos challenge

In the MOS camp there is again very little to choose between the various contenders. Both CMOS and NMOS have about the same power/speed product, but CMOS suffers a slight disadvantage when it comes to pack-into density. This is because CMOS transistor must be electrically insulated from its P-MOS partner and the insulation takes up room.

It also has the disadvantage of demanding more steps than NMOS in the fabrication process.

But CMOS has one outstanding advantage which neither bipolar nor NMOS are likely to better. CMOS transistors do not consume any power when in the quiescent state. Only when they are actively doing something, do they demand a current.

Some experts say that this could cause CMOS to overtake both NMOS and bipolar in the near future. Such predictions are largely based on the increasing demand for battery-powered systems in the automobile and consumer markets.

The MOS chips are certainly hard to beat. Device improvement over the past five years has meant circuit density on NMOS random logic has increased from 100 gates per square millimeter to 300 gates per square millimeter. Over the next 10 years this may well be improved still further to 1,000 gates per square millimeter, with speed/power products of only 0.2 pica Joules. CMOS comes nowhere near this at the moment.

However, once the device size gets really small, below say 1,000 gates per millimeter squared, NMOS suffers from increased contact resistance and there is a tendency for time delays to be introduced because of capacitive effects. Again CMOS could gain ground here. It does not suffer from the same drawbacks and offers better tolerance to temperature and noise.

Bernard Murphy, a Bell researcher has been quoted thus: "Since power dissipation in present designs is at about the tolerable limit, the trend in NMOS designs must be to trade off speed for lower power dissipation. CMOS is less restricted in this way, and will I believe, become the dominant technology for VLSI." (Technology Ireland, May 1983.)

VLSI

When VLSI does emerge it will mean more than just the provision of faster, cheaper, more complex designs. It will also mean almost a complete restructuring of the relationships between the chip manufacturer, the end user and the systems designers.

Even LSI, as it stands now, is very expensive, both in terms of capital investment and facilities. VLSI will be more so. Only the very biggest of the dedicated companies will be able to afford it. It is this fact, among others, that will encourage a closer liaison between the systems designer and the chip manufacturer.

At the moment, designers like those engaged in microcomputers are restricted in their choice of hardware. The only way they can gain advantage over competitors is by clever design of software. But if the advent of VLSI is accompanied by an increasing use of customisation, the designer may be able to avail of better hardware as well. Liaison with the semiconductor houses may produce hardware 'specials', perhaps designed to suit particular users and particular markets.

There is an interesting marketing dynamic here: the chip manufacturers do not like the market risk of processors. Instead, they prefer the relative security of producing memory. For this reason, there may be a trend towards involving the systems-houses more in processor design.

If this happens, the systems houses can acquire the hardware advantage discussed above, and the semiconductor houses can be rid of the market risk. All the chip manufacturer would do is supply the customised processor chip and memory. If the processor flopped on the market, the systems house would take the rap.

Predictions also have it that this will mean a proliferation of small design houses, whose function it will be to interface the microcomputer manufacturers to the chip manufacturers. Each design company will consist of no more than 30 or 40 specialists who can turn systems requirements into VLSI designs. (Technology Ireland, May 1983.)

Chip design

Computer-men are challenging the idea that smaller is better in microelectronics. Instead of trying to cram ever more circuitry on chips a few millimetres square, researchers are trying to link together the equivalent of many individual chips on wafers of silicon three to four inches in diameter. If the bugs can be overcome, they reckon such super-chips will be more capable and easier to operate than the collection of individual chips they replace.

One Silicon Valley company, Trilogy Computers, is staking its future on this chip-making technique, called wafer-scale integration (wsi). Trilogy's founder, Mr. Gene Amdahl, promises to introduce the first commercial wsi chips soon. With about 40 such chips, he reckons he can make an IBM-compatible computer that will out-perform anything IBM can offer, and cost less. Specifically, wafer-scale integration offers three potential advantages over conventional chip-making techniques. The most important is that, with so much space to play with, designers can add redundancy to its circuits. Suppose they want to build a super-chip whose functions require the equivalent of one conventional memory chip. They can actually build in the equivalent of several conventional memory chips, and, if one fails, the chip can - in theory at least - be designed to switch its operations automatically on to the back-up units. Computer breakdowns and maintenance would be kept to the bare minimum. Second, because the different circuits are closer together than they would be if they were on separate chips, they can communicate with each other faster and more easily. Third, wsi chips are easier to cool than conventional chips. That matters - one of the nightmares of the computer designer is that his new wonder machine will throw off so much heat that it melts its own circuits. The snag with wsi is that the extra complexity of the chips makes manufacturing defects inevitable. Silicon wafers as big as three to four inches in diameter

carry small local defects in the structure of the material that knock out the circuits printed over them. Manufacturing problems also make some other areas of the wafer useless. Overcoming these flaws is very difficult. Even finding the flaws is tricky. Because wsi chips contain so many circuits, the faulty ones cannot be located by conventional testing.

In theory, one could first print the individual sub-units (eg, memories) on to the wafer, test them separately, and then connect together only the working ones into the final product. But that would be prohibitively expensive. Creating circuits on silicon is tricky, and, because each of the wafers would have different defects, the interconnecting circuitry would have to be tailor-made.

So wsi chip-makers are taking a different approach. They are trying to make the chips as defect-proof as possible by, for example, making the individual sub-units larger than their conventional chip equivalents. And they are trying to give the chips the ability to diagnose their own faults.

Much of the research done so far on self-diagnostics concerns wsi memory chips. Researchers at the Massachusetts Institute of Technology have created a 128k-bit memory chip with just enough self-diagnostic capability to tell a testing machine which of its circuits are not working. Once located, those circuits can then easily be knocked out by an electron beam to leave a functioning memory wafer. Although 128k memory is not a great prize, the researchers hope the same techniques could be used to expand its capacity 10 or 20 times - outstripping conventional chips. Burroughs is working on a more ambitious idea. Instead of simply being able to tell a testing machine which of its circuits are faulty, its chip is being designed to test its own circuits, and itself automatically re-route its "wiring". Other companies are also interested in wsi technology. Immos, for example, is toying with the idea of creating its fifth-generation computer on a single wafer instead of 256 individual chips. The redundant circuits built into the wafer, Immos reckons, might also be used to boost the super-chip's ability to handle large amounts of data through parallel processing - that is, to have several circuits working on the same problem at the same time. Sceptics will believe in the wonders of wsi technology when they see them working. They reckon the complexity of the chips and of the self-diagnostic systems will make them expensive and unreliable. All eyes are now on Trilogy, whose products should provide the wsi technology's first success, or failure. (The Economist, 23 July 1983.)

Getting computers to design their own chips

Chip designers are keen to get computers themselves into the act. The reason is simple enough. You can already cram 100,000 or so transistors on to a chip - and a 1m-transistor chip is in sight. Designing the layout of such chips requires expensive (and inevitably errorprone) teamwork. America's Intel says it took four calendar years and no fewer than 50 man-years to design its latest 16-bit chip, the 286. Computers, everyone agrees, can produce short-cuts, though there is debate about how best to use them. Consider three very different problems: the final laying out of a semicustomised chip; the juggling around of standard chip elements to create a design for a low-volume chip; and the design of an utterly new high-volume chip. Using a computer to tackle the first problem is relatively straight forward. A good example is the completion of so-called gate-array chips. These chips are largely pre-processed and need only the laying out of particular connections among their elements to customise them to do a particular job. Often the design of the final layout is wasteful; it uses more space on the chip than necessary. One firm trying to develop design software to minimise such waste is a start-up company based in Edinburgh, Scotland, Lattice Logic. The next step is to use a computer not simply to make connections between elements on a chip but also to specify the standard elements to be connected up. Programmes that do this are known as silicon compilers (Lattice Logic is working on such programmes, too). Using a compiler, a designer can specify the basic parameters of the chip he wants, rather as he could order up a meal in a restaurant. The compiler then acts as a cookbook, detailing the ingredients needed and how to put them together. For example, you might ask for a so-called arithmetic unit (the circuitry that carries out binary sums) plus some random-access memory. The computer programme would be left to put these ingredients together.

A Silicon Valley start-up company, Silicon Compilers, has used this approach to design a complicated communications chip for use in Ethernet networks for a fellow start-up, Seeq. According to Silicon Compiler's founder, Dr. David Johannsen, a designer can simply feed his company's software with a short-hand notation of what he wants his chip to do and then let the computer boil down (compile) the information and produce a complete layout. Magnified pictures of the Ethernet chip show the hallmarks of a computer at work. The chip has an unusually highly ordered, methodical appearance.

Critics say that this may be fine when it comes to the design of small-volume, custom chips but point to two snags. First, you would still need to develop software to check whether the resulting design fits together properly - albeit the compiler should be more accurate than a human designer. Second, a silicon compiler also tends to waste space on a chip - because it must juggle fairly standard solutions. When it comes to designing an imaginative chip aimed for a mass market, the critics say, compiler will not do. There is no substitute for the ingenuity of human designers then. Compilers simply do not have the flexibility of the human brain. You need a master chef - not a robot with a cookbook - to produce a three-star meal.

Perhaps. But, even if they cannot replace them, computers can aid human designers in creating clever chips. So says Britain's Immos. And some big American chip-makers are impressed enough to want to buy the design system it has developed. Rather than specifying new ways of laying out standard components (Immos, too, uses silicon compilers for that), its software generates new components that designers specify in considerable detail. It is a design aid rather than a design substitute, filling in only fine detail. And the designs it throws up can be tested without the need for extra software.

What savings does the Immos system produce? Immos says that it has done a design comparable to Intel's 50-man-year, four-calendar-year one using just three man-years in six months. Its chip is a microprocessor called a transputer and, says Immos, outperforms most other 16-bit microprocessors - in simulated trials anyway. Mind, Intel's 286 chip already exists. Immos's transputer chip is yet to be produced. (The Economist, 19 March 1983.)

Gallium arsenide chips

In the race to develop the next generation of high-speed microchips, Japanese electronics companies are putting their money on gallium arsenide. But gallium-arsenide chips are much trickier to produce than silicon chips. Designs proliferate in the laboratories of Fujitsu, Hitachi, Nippon Electric, Toshiba, etc. The challenge is to get these super-slick chips out of the lab and into mass production. There are two main problems: getting enough high-quality gallium arsenide to build lots of chips; and developing a reliable chip-making process. The first problem is close to a solution, but the second is not. Companies disagree on the best approach to adopt. In April, Japan's optoelectronics joint research laboratory will announce the final version of a new process for making high-quality gallium arsenide. It is the first stage of an ¥18 billion (\$75m) project set up by Miti and the electronics companies to close the technology gap between silicon and gallium arsenide. Mr. Izuo Hayashi, the lab's director, reckons that at the moment understanding of gallium arsenide is 20 years behind that of silicon. He hopes that in six years - the project's lifespan - he can make gallium arsenide as easy to cope with as silicon is today. The long-term aim is to produce a gallium-arsenide chip that switches optical as well as digital electronic signals. But that is still on the drawing board. The new crystal-producing method is a refinement of an existing process, known as liquid encapsulated Czochralski (lec), in which a brew of gallium and arsenic is heated to melting-point. To stop the arsenic atoms evaporating, the melt is covered with a layer of boron oxide, and placed in a pressurised atmosphere of argon gas. A "seed" crystal is dipped into the gallium arsenide, and the crystal and liquid are rotated in opposite directions as the crystal is withdrawn. Hey presto, a fully grown gallium-arsenide crystal is pulled out.

There are two big snags. The crystal contains silicon impurities which can ruin a chip's performance. And pulling the crystal out of the melt without carefully controlling its diameter causes so-called dislocations. Molecules slip out of place in the otherwise highly regular lattice. Dislocations impede the movement of electrons - and thus destroy gallium arsenide's speed advantage over silicon. Dr. Tsugo Fukuda and his team at the joint research lab have modified the basic lec process to get round these problems. First, a personal computer was linked to the crystal-pulling mechanism to control the crystal's diameter. It maintains a constant relationship between the length and weight of the crystal. This trick reduces dislocations a thousand fold. Second, Dr. Fukuda invented a way of purifying the crystal as it is pulled from the melt. The pressure of the argon gas is suddenly cut from nearly 50 atmospheres to one atmosphere. The boron oxide bubbles, and the impurities are distilled out of the melt. But that trick leads to other difficulties. Distillation sets up convection currents which cause more dislocations. To get round that one, Dr. Fukuda created a magnetic field round the melt to calm down the currents.

Toshiba, from whom Dr. Fukuda has been seconded to the optoelectronic research lab, believes the only practical approach is to use a process similar to that employed for silicon chips - etching circuits on to the chip. Toshiba has already developed a gallium-arsenide gate-array chip with 500 gates on it, and it has a chip with 1000 gates lurking in its Kawasaki research labs. Fujitsu, meanwhile, is developing a so-called high-electron-mobility

transistor (hemt), which should work much faster than chip elements designed to Toshiba's philosophy. In theory. The trouble is that to gain their speed, hemt elements have to be chilled to liquid nitrogen temperatures - a messy problem for computer designers to have to contend with. Building hemt chips is proving difficult, too. Hemt requires a sandwich of layers of gallium arsenide and other semiconducting materials each only 10 molecules thick. It is notoriously difficult to control the thickness of the layers; thus far, Fujitsu has fabricated only the simplest of circuits on its hemt chips. Disparaging critics say these circuits are to a working microchip as a valve is to one of today's state-of-the-art silicon chips. (The Economist, 5 February 1983.)

Designing the 8 million-bit chip

The next generation of computers will be several times faster at carrying out the millions of instructions a second which present-day computers can just about handle. Making the chips for these computers presents some sticky problems of miniaturisation. Smaller chips are better because it takes less time for electrons to pass from one point on the chip to another and you can pack more of them into one box. But what must not be lost is complexity - in fact if you can make smaller chips that are even more complex then so much the better. Circuit designers are looking forward to building chips that can store 8 million bits of information - 32 times more than the 256K-bit chip most manufacturers are working on. But, as more electrons whizz up and down shorter "highways", the heat which they generate causes the biggest headache for chip makers.

Over the years designers have steadily decreased heat dissipation in chips. One method is to lower the operating voltages of components. This process cannot continue indefinitely, however, because circuits require minimum shifts in voltage to make them change state.

The excess heat produces "hot" electrons in the surface layer of silicon dioxide. These can migrate into the active semiconductor regions of a device and alter the minimum voltage necessary to change its state. As components are designed that are smaller, with correspondingly fewer charge carriers in each device, so these effects become significant.

So much for damage to the semiconductor materials: what about the aluminium wires carrying electrons between components? With very narrow wires, high densities of current make the atoms migrate into the silicon base of the chip. This brings the risk that eventually the circuit could be broken. Such electro-migration can be reduced by choosing a different conductor, but it cannot be eliminated entirely.

Electrical resistance also increases as wires become narrower, producing significant voltage drops which again threaten the operation of the devices as well as dissipating more heat.... (New Scientist, 9 June 1983.)

Customised semiconductor materials are on their way

Superlattices may be the key to the next generation of chips. Today, the wafers from which chips are made are usually sliced from single crystals of one material: eg, silicon or gallium arsenide. Superlattices are composites: that is, crystals built up of alternating layers of various compounds. The Japanese are hard at work at such composite semiconductors. Under a \$1.4m Miti-sponsored programme, Fujitsu, Hitachi and Sumitomo are making chips out of alternating layers of gallium arsenide and aluminium arsenide. Now researchers at America's Sandia National Laboratories in Albuquerque, New Mexico, may have stolen a march on them by developing something called a strained-layer superlattice, or SLS for short.

There are a number of reasons why research has been pushing ahead on superlattice semi-conductors. For a start, chips made from them promise to work at higher speeds and temperatures than conventional ones. The main problem has been that, using ordinary techniques of crystal generation, the different layers do not marry up neatly. Because the crystalline structures of the materials in the composite differ, the boundaries between the layers contain defects which degrade the performance of chips made from them. This is the problem that Sandia has solved with its SLS technique. In an SLS superlattice, the different layers are extraordinarily thin. They are less than 30 millionths of a millimetre thick - that is, just a few atoms thick. Layers this thin are effectively elastic: the outermost strata of atoms can deform to accommodate each other. Instead of mismatching to create defects, the atomic boundaries of the layers align under the strain of crystal generation. The result is almost perfect composite crystals - and so high-performance devices. There is another plus. The Sandia researchers think that SLS crystals can be tailor-made to suit almost any requirement, because they can marry up a wide range of different materials. For instance, you could make superlattices combining gallium arsenide, gallium phosphide and indium gallium arsenide.

How well any semiconductor will perform in a given application depends in part on something known as its bandgap. This refers to a gap between two energy states. A semiconductor has a so-called valence band and a conduction band and the name of the game is to make electrons (or positive "holes") jump from the valence to the conduction band. The bigger the bandgap, the more energy is required to effect the jump. Usually the bandgap is a given. Each semiconductor material has its own characteristic bandgap and you simply have to choose the one that best suits your needs. Superlattices open up the possibility of creating precisely the bandgap you would ideally like. The bandgap characteristic of the superlattice as a whole will be slightly different from that characteristic of any one of its individual component materials. Vary the mix (and thickness) of the component layers and you should be able to vary the bandgap to order. The Japanese have been working on superlattices primarily to develop chips for straight electronics applications, eg, fifth-generation computers. Sandia thinks that the biggest potential for its superlattices may be in optoelectronic applications. For example, super-bright lightemitting diodes (leds) could be made from SLS superlattices. More exciting still (though something that Sandia is not talking about) is the possibility of using SLS superlattices to make leds whose emission wavelengths could be precisely "tuned" to minimise the attenuation of light signals sent down optical fibres. It should also be possible to create the first-ever green solid-state laser; that would have applications in, eg, optical data processing. Not surprisingly, a number of other groups are now interested in SLS, including the American semiconductor-equipment manufacturer, Varian Associates.

Exploiting superlattices commercially will require specialised techniques for depositing very thin layers of semiconducting materials on to substrates. There are two runners: molecular-beam epitaxy and metal-organic chemical-vapour deposition. Both are still in the development stage, but molecular-beam epitaxy (or MBE) looks closest to the mass-production line. MBE typically works by using an electron beam to evaporate and focus on to a substrate each element wanted for a crystal. The different elements are deposited on the substrate in layers just a few atoms deep at a time. The technique is extremely precise. It is also painfully slow: it would take an hour to build up a sandwich a micron (a thousandth of a millimetre) thick. Fortunately, for the ultra-thin layers wanted for superlattices, this sluggishness is not a crippling disadvantage. MBE has so far been developed mostly in conjunction with work on gallium-arsenide devices. Intriguingly, scientists at America's Bell Labs have now demonstrated that it can be used to deposit thin layers of silicon as well. So it looks as if further speed improvements in good old silicon chips are also on the cards. (The Economist, 16 July 1983.)

Putting organic molecules to work

Engineering and biology are beginning to join hands. Most of the research is going into possible electronics applications, for two good reasons. First, organic molecules can have interesting electrical properties, acting as semiconductors - indeed, under certain conditions, as superconductors. Second, they are small: in theory, even a two-dimensional biochip could hold a million times more devices than a conventional silicon chip. Nobody has yet managed to make a true biochip - let alone a biocomputer. Experiments with natural cellular materials are being done: for instance, America's Centronix Laboratories is investigating the possible use of muscle fibre to build up three-dimensional electronic circuits. But most research groups are concentrating on organic molecules (that is, molecules containing carbon and other atoms) from the chemist's shelf and on constructing single devices.

Getting functional organic electronic devices and then connecting them up on chips is going to be a long haul. But one technique that researchers in this area have been using in their work could find electronics applications in the more immediate future. It is the technique of depositing on to a substrate (like silicon) films of materials that are just one molecule thick.... (The Economist, 4 June 1983.)

Relief for chip-shop eyes

A new machine should be a sight for sore eyes at semiconductor factories. The Chip-check, made by Cambridge Instruments, automatically inspects the masks used to etch circuits onto silicon. Despite efforts to automate chip factories, some jobs can be done only by humans. Often they are the most tedious ones, involving inspecting and wiring chips under microscopes. Chipcheck uses a camera to scan masks, a process which takes less than half an hour for a chip 6 mm square compared with the days it can take to inspect manually one of the latest million-transistor chip masks. The image is digitised and compared with the original data produced by the chip's designer sitting at a computer screen. (New Scientist, 19 May 1983.)

Using artificial intelligence to test integrated circuits

Researchers at Battelle-Geneva are developing a new method for testing and visually inspecting integrated circuits. The method uses artificial intelligence approaches and unique sensor combinations. In its present state the Battelle method - which also can be adapted to hybrid circuits and printed circuit boards - substantially reduces the imaging and electrical testing times. It also reduces the non-detection and false alarm rates. These advantages have been validated through earlier experimentation. Major applications for these developments are for both digital and analog integrated circuits, and for monolithic sensors used in high-reliability electronic and information processing systems. (Battelle Today, June 1983.)

Chips off old blocks

As microchips become ever smaller and faster, the more difficult it is to prevent them overheating. One way is to increase the rate the circuit boards on which the chips are mounted conduct away the heat. Scientists at a British research association believe that this can be done by replacing plastic and alumina boards with sheets of steel coated with an insulating layer of vitreous enamel similar to that in domestic cookers. ERA Technology of Leatherhead has combined the latest high-grade enamels with screen-printed conductor films selected for their compatibility with the low firing temperatures that vitreous materials need. Chip carriers are mounted by a technique in which the solder is heated by immersing the board in a vapour bath. The new boards are cheap and strong. If they dissipate heat as well as the scientists expect, enamelled steel could take over from both alumina and plastic. (New Scientist, 7 July 1983.)

Automated growth of silicon crystals

An automated silicon-crystal-growing system developed by Ferrofluidics (Nashua, N.H.) will get its first application by an unidentified Japanese company. The computer-controlled system is used to grow mono-crystalline silicon ingots, the initial process in the manufacture of microprocessor chips, other integrated circuits and photovoltaic solar cells. The system also includes an innovative crystal-removal step, which eliminates the need for operators to manually remove the hot, heavy ingots. Ferrofluids, which are the basis of the system, are fluids that are responsive to magnetic influences. These fluids can be precisely positioned by external magnetic fields. (Chemical Week, 8 June 1983.)

APPLICATIONS

Computer hooked to hand loom

AVL Looms, Chico, California 95926 (USA) have produced an example of intermediate technology by adding an Apple microcomputer to their hand loom which makes it possible to design new fabric patterns on an electronic screen and then have the computer instruct the dobbie head to reproduce that pattern on the loom. The computer can then store the pattern for future use.

In 1980, AVL participated in a "Technology for the People" trade conference in Geneva and established contact with business representatives from Western Europe and many developing countries. It has now formed a small international subsidiary, AVL International, and is starting to market its looms in other countries and explore the possibility of participating in joint ventures in developing countries which will help to create productive work for many unemployed or underemployed persons in those countries. AVL looms are now at work in Austria, Great Britain, Mexico, Thailand, and Indonesia. A joint venture is being planned for India, and looms will soon be in operation in a number of other countries as well.

Community Memory project, Berkeley, Ca. (USA)

Community Memory is designed as a powerful and public system for communications and information exchange. Its medium will be computer technology: a network of relatively small and cheap computers, each connected to a dozen or more terminals located mostly in public places such as neighbourhood centers, cafes, bookstores, and libraries. The Community Memory system will provide simple yet powerful ways to store and label information, which can then be browsed, selected, sorted, and fished out. All the facilities of the system are available to all its users: anyone can post messages, read messages, and add comments or suggestions to them. Community Memory can be used as a community filing cabinet, a continuously available conversation on any topic whatsoever, a place for people with common interests to find each other, a tool for collective thinking, planning, organizing, and fantasizing.

Messages on the Community Memory system might include:

- Announcements and comments on current events, entertainment, restaurants;
- Debates about community and political activities;
- Listings of community resources;
- Information about bartering, buying, selling, and renting;
- Notices about groups being formed;
- Graffiti, poems, dialogues, and "multilogues".

Since the users themselves are the source of information in the Community Memory, the system is not subject to the various kinds of constraints imposed by commercial "information providers".

What hardware - computer, disk storage, terminals, modems - will a Community Memory system require? Its average node should be able to connect 16 to 20 terminals at one time. Computer and disk storage should operate with enough speed and efficiency to give users good service. The terminals should be easy and comfortable to use, and might have a joystick, mouse, or touch pad, as well as a keyboard, for fast or fancy message maneuvering. (Information on the above two items was provided by the Council on International and Public Affairs, New York, NY.)

Chip to control induction motors

A single chip, programmed to control three-phase electric induction motors, is now commercially available which saves energy, allows heavy industrial motors to start up smoothly and switches off operations when a fault is detected. Fairford Electronics, a small Devon-based firm, is programming Motorola chips and selling them at less than £30 to existing manufacturers of control gear. According to Ray Bristow, initiator of the controller's development, the real breakthrough has been in analysing the highly complex logic involved in three-phase control and reducing the number of programming statements to fit onto a single chip.

The chip is programmed to monitor the amount of work being done by an electric motor and alter the power intake to match. It assesses the work output, or the "load", by constantly monitoring the phase lag between voltage and current waveforms, which increases as the motor's load decreases.

But the Fairford chip is not merely aimed at energy savings. According to Bristow, because the chip controls the amount of energy going into the motor, it can increase the supply gradually to provide a so-called "soft start", reducing the degree of stress endured by heavy industrial machinery when switched on. The chip is also programmed to detect faults resulting in loss of current in a phase. When this happens the motor is automatically shut down. (Financial Times, 11 March 1983.)

Process control

For the past 20 years or so many plants have been operating semi-automatic process control systems. Plants use a control room or control panel from which pumps, valves, compressors, or other equipment in remote locations can be stopped and started. The great jump forward with microprocessors is that they allow you to stop or start this equipment in any sequence you like, with many different timings between steps. Typically, for £800 you can get a programmable logic controller (PLC) which can open and close 10 valves, stop and start 10 motors etc. in any sequence. Bigger systems require bigger PLC's and a bigger budget.

Computers are now used to control very large plants - thousands of valves, motors, and other equipment - and give complete management information on plant performance. These big systems are fine, provided you can get a huge budget. The present state-of-the-art however makes it very attractive to automate bit by bit, starting with the least critical portion, using it as learning experience. The concept of having one big computer running the entire plant was in vogue up until 1980 when the really low cost microprocessors came into their own. The current trend is towards decentralised control, where each section has a computer controlling its operation.

In a dairy, for example, you might have one microprocessor controlling a group of 3 pasteurizers, one controlling a cleaning in place (CIP) washing set, another controlling raw milk cooling and storage, and so on. This form of 'distributed control' has distinct advantages. Each block can act independently of the other. If one microprocessor fails for any reason, the rest can carry on independently. In a typical existing plant, the engineer

will install a microprocessor for each section, but the ultimate aim is to have the plant controlled from one room. Therefore, a management computer is used to control the various microprocessors. The microprocessors in turn provide information to the management machine so that the overall plant records such data as temperature, pressure, flows, tank levels for management use while in operation.

The biggest hassle here is inter-communication between microprocessors and management computers of different manufacturers. In general, microprocessors and management computers of the same manufacture can communicate; there are well established systems for getting microprocessors and microcomputers (desk tops) of specific different makes to 'talk' to each other. However, mixing up all sorts of microprocessors normally leads to trouble later on.

All microprocessor systems must be designed to cater for failure. What if the microprocessor blows up? One can't have dirty milk tanks, nor leave cream in tanks for days to go off because the emptying program doesn't work. So we have a back-up. Typically, this could be a mimic panel or VDU. This equipment allows each valve to be manually controlled in the event of failure. A must.

Also a must is feedback from the system - that is, if a valve hasn't opened as instructed, a signal from a proximity switch says so, and the microprocessor stops the program and alarms. This is a great security and a great feature of the microprocessor. The biggest plus for a micro based system is the repeatability. Every day, each piece is washed at correct temperature with correct chemical for the right duration. Problems tend to be 95 per cent mechanical, for example caustic dosing pump failure, wet limit switches, caking on level probes (especially in hard water areas) etc. The operators and dairy electrician usually learn how to use the system, change programs etc. in a day, given a standard microprocessor. Other process control applications now include batching, in-line blending, milk transfer and - very interesting - Bailieboro Co-Op's microprocessor control of an evaporator. It is important to have a local supplier to install the system, for you'll need to change it, expand it, or modify it somehow. That will cost a lot in time and money if there's no Irish back-up.

Ultimately, the larger dairies will be computer controlled - run by one man or maybe none. Such a plant is that of the Dutch Co-Op Coberco whose butter factory is the largest in Europe. It processes 700 million litres of milk a year, and the entire processing/cleaning section is controlled by one man. Labour is used for tanker unloading and tending the packaging machines. At weekends, the plant is unmanned, but if there's a problem, the computer rings the operator who is 'on call' at home, to alert him.

Other industries where computerised process control will take over soon include:

- Chemicals
- Milling
- Meat Processing
- Energy Systems
- Food Processing (all types)
- Plastics.

(Technology Ireland, June 1983.)

Micro control for keg racking

A keg-racking system for breweries which gives significant improvements in line efficiency is being manufactured and marketed by Stonefield throughout the UK. Developed by Canongate Technology, a division of Scottish and Newcastle Breweries plc, the system has been successfully running on both Ruddick and Centrimatics racking machine lines at Scottish and Newcastle installations for several years. It was originally developed to retro-fit racking machines, but can be applied with great advantage to new lines. The microprocessor control, usually one for each two lanes, replaces all the solid state/relay electronics usually employed by keg-racking manufacturers. The micros are housed in a standard 19in.-wide cabinet and four retrofits occupy the space of the old electronics. Typically four micros, controlling eight lanes, can be housed in one cabinet. These micros are connected via a single, three-wire daisy-chain back to a central computer.

Through the computer key-board the operator can also set information for each lane. For example, to define the key size, or whether a lane is to be calibrated for filling, or whether it is to be "clean only" when kegs are destined for storage.

An important aspect of the system is its ability to identify reasons for rejects. Each lane monitors for feedbacks to indicate correct temperatures, triple rejects, drain times, etc, and will alarm if any event is in error. This information can then be fed to the central system which will display the fault, either on a VDU, or a printer. The system has a number of other advantages for brewery operators. It provides greater speed, greater consistency of filling and higher product security - a failure will affect only a small part of the line. Installation is easy and can be phased to enable lines to be converted in stages. Costs are lower, as all replacement spares for the micro control systems are identical. Detailed management and maintenance information is available, both on the central computer's VDU and on mimic diagrams, an optional extra. Current and historical status of each lane is instantly available and this information can be typed out for record purposes, or to present to maintenance for fault rectification. If a disk option is added to the central computer, then historical data can be stored to allow long-term trends to be established. Other areas closely involved with the keg-racking line can also be controlled. Information from check weighers can be made available, services such as beer supply, CO₂ and air can be monitored for any interruptions, and lane starvation at the washing station can be prevented. This is achieved by a keg-picking routine which, once kegs enter the in-feed system, ensures that each keg is allocated to a specific lane and can only be accepted by that lane. (Electronics Weekly, 6 July 1983.)

Railway to test speech recognition equipment

Claiming to be the first railway in Europe to experiment with speech recognition, French Railways are testing equipment at Reims for converting spoken station names into telephone dialling code. The installation, in the traffic regulators' office, consists of a mini-computer and a 16-bit microprocessor. At present it recognises only one voice, but the next step will be for each regulator to record his own voice on a tape, which will be read into the computer when he comes on duty to form his individual recognition pattern.

The regulator wears a microphone clipped to his tie and when the name of a station to be called has been recognised it is shown on an LED panel as confirmation that the dialling code is being generated. When the call is answered, the regulator presses a pedal to switch off his microphone and uses the ordinary telephone handset so that other station names mentioned during a call do not reach the equipment. If a name is not recognised the LED panel displays 'Please repeat'.

Tests in a quiet background have shown 95 per cent success in recognising names the first time they are spoken. Against a noisy background the rate has dropped to 85 per cent. With the present equipment names must be spoken separately with a pause of 300 to 400 milliseconds between them but experiments are already in hand with a second-generation system that will handle continuous speech. (Electronics Weekly, 11 May 1983.)

Electricity meters

Thanks to microchips, even the humble electricity meter has become a high-technology item. Britain's South Eastern Electricity Board (Seeboard) has developed a meter called Calmu, which, it reckons, can eliminate the need for people to trudge about reading meters, speed up payments and allow flexible electricity charges. Calmu automatically measures how much electricity a consumer uses, calculates the bill and relays it back to a utility's computer. For now, Calmu uses telephone lines for communication - sending its signals when the telephone is not in use - but it can also use fibre optics, low-frequency radio waves or even the power lines themselves. The technology to do all this has been around for years. The real achievement of Calmu's inventors - Mr. Robert Preddie and Mr. John Fielden - was to make the device cost no more than a conventional meter (about £80) and do more.

In addition to billing, Calmu can:

- Monitor safety. The microprocessors shut off the circuits when, say, an appliance short circuits. And they automatically tell a utility's computer if anything is going wrong with the basic wiring of a customer's house.
- Allow electronic payment. Linked to a bank's computer, the device could enable customers to pay their bills with the touch of a button.
- Offer flexible rates. With Calmu, utilities can begin to charge customers according to the marginal cost of generating electricity. This varies by several hundred per cent over the course of a day - peaking when demand is high (and utilities have to crank up their least efficient plants) and dipping as demand drops. (The Economist, 4 June 1983.)

Computer-based weather station

The current revolution in microelectronics has paved the way for improvements in yet another important piece of equipment. Mr. Brian O'Neill of the CSIRO Division of Tropical Crops and Pastures has exploited this technology and also made use of another piece of silicon-based technology - the solar cell - to develop a fully automated weather station.

His solar-powered, computer-based station handles more weather data and looks like being cheaper and more reliable than currently available automatic weather stations. A sophisticated but durable array of instruments and sensors measure the air, grass (the so-called terrestrial minimum) and soil temperatures, the humidity, wind, rainfall and solar radiation. A small, inclined panel of 20 solar cells sits atop the standard Stevenson screen - the louvered cabinet. The solar panel produces electricity for the microcomputer and instruments housed inside. The cells also power the anemometer, the humidity and temperature sensors, the rain gauge, solarimeter and the 'suitcase' computer. The station's microcomputer continuously monitors the sensors and stores a daily summary of results for up to 96 days between data collections. An operator can extract all the information stored in under 5 min by hooking the suitcase computer into the system. This computer can be linked to main terminals such as CSIRONET; and, being similar to a home computer, it can be used for other purposes besides handling weather data.

At the time of going to press, CSIRO is considering proposals from companies interested in the commercial development of the weather station. The Division envisages that commercial models will be equipped with a telephone line that would link the station to a central computer. Weather data would then be 'on-line' and available at any time. Because few trips are needed to collect data from the new station, the costs of weather watching would be greatly reduced. The automated station should prove valuable for research groups, and it will undoubtedly have a role to play in helping to fill gaps in weather recording in remote areas of Australia such as the Simpson Desert and the coal-mining areas of central Queensland.

For more information: CSIRO Division of Tropical Crops and Pastures, 306 Darmody Road, St. Lucia, Qld 4067, Phone (07) 377 0209. (CSIRO Industrial Research News, March 1983.)

Ship computer clears the decks

Computers have moved in to make the whole business of filling cargo holds less haphazard and more efficient. In the van of this dockside revolution is the Liverpool firm of Coubro and Scrutton, which has been involved in the more traditional kind of cargo handling since the 18th century, when it used to make block and tackle. Now the company has made a technological leap which has won it orders from India, Holland, Italy, Poland, Japan - and even a £100,000 contract from the super-efficient South Korean yard of Hyundai. Before loading, the relevant data about the ship and cargo is fed into a microcomputer which can calculate up to 30 different types of lashing at various angles and strengths. In minute flashes on the computer screen showing exactly where the cargo should be secured. Lashing is cut dramatically. In the South Korean order the final rigging system uses 30% less lashing equipment for the same cargo weight.

The company decided to invest in software. Helped by the Liverpool consultancy firm Anchor Marine and Lloyds Register of Shipping, Coubro developed its cargo securing system, called the Lashing Work Planner. Coubro also wants to sell its software direct to ship-owners, so they can solve lashing problems themselves. With many vessels now carrying computers on board to control stocks and wages, Campbell reckons he must have a winner. (The Sunday Times, 22 May 1983.)

Dutch firm launches automated lab

Philips's idea of an automated laboratory, which it launched last week, is based around a common minicomputer, the DEC PDP 11. The firm says that it has designed all the instruments so that they can be operated by "even a relatively unskilled junior technician" or the "staff non-specialist".

A company spokesman says the new generation of equipment will provide laboratory workers with "an opportunity for the creation, and not the annihilation of work. Applied science, for example, can be helped by equipment like this by tackling jobs that are now too time-consuming". (New Scientist, 7 July 1983.)

Microcomputer smarten up ultrasonic testing

Although commercially available for the past 20 years or so, ultrasonic detectors never really caught on as a diagnostic or maintenance tool in the chemical process industries. The biggest problem with ultrasonic detectors was their inability to produce measurements as accurately or as consistently as could many competing devices for nondestructive testing. The advent of microprocessing is dramatically improving the ability of ultrasonics to detect the wall thickness of metal and plastic pipes and process vessels; to determine particle dispersion in suspensions; and to detect potential leakage and faulty parts in pumps, steam traps and valves.

The microprocessor - which converts electrical signals produced by ultrasonic detectors to a digital format - is able to control logic and do a thorough and rapid job in the computation required for good measurement, according to John Kopp, senior applications engineer for Fischer & Porter (Warminster, Pa.). Harry G. Conner, principal consultant to the instrumentation and process control group in Du Pont's engineering department, echoes this opinion. The use of microprocessors, he says, will make ultrasonic devices easier to operate and increase their accuracy by providing readings with more significant digits. (Chemical Week, 18 May 1983.)

Computerised cars take to the road

Cars controlled by electronics instead of by a cumbersome wiring harnesses have been "five years away" for decades. But last week the concept came a little closer to reality when an electronics company unveiled a car that it hopes will spur manufacturers into the information revolution. Motorola's "Motocar" is a standard Lancia Delta, packed with electronic wizardry, including 23 "computers on a chip". Some of their functions - such as a memory that controls four different settings for the driver's seat and mirror - are a little gimmicky. But Motorola says the car is a serious demonstration of what electronics can do to make motoring safer, more economical and more pleasant. More to the point, the company's engineers predict that within three years it will be economically viable for car companies to fit multiplex wires carrying a variety of instructions rather than the cumbersome harness with one wire for every job. Motorola has replaced 500 metres of standard wiring with 75 metres of multiplexed wire and fibre optics. The result should be easier and cheaper to make and to install, and also more reliable. The real benefit should be in servicing: one diagnostics socket can supply information about the whole car. The main wire multiplex, which forms an "H" shape around the car, consists of four wires. One carries the battery positive line (current returns via the chassis as normal); the second provides the ground for electronics at the different "outstations"; the third transfers data to and from the different outstations, and the fourth synchronises the signals.

In parallel with the multiplex network, a link via optical fibres controls the position of the seats, windows, central locking and the door mirrors. Each fibre has a combined emitter and detector, so it can work in both directions. For most drivers, it will not make much difference whether optical fibres or wires control the car's brake lights. But the increased ability to handle information should allow car makers to fit a range of enticing gadgets to woo fashion-conscious customers. Among the possibilities that Motorola demonstrated are a remote control for door locks and windows, an LED display giving information ranging from "door not closed" to rate of fuel consumption, and a fail-safe cruise control system. (New Scientist, 19 May 1983.)

Diet by computer

A sophisticated software program that will break down the exact nutritional content of a patient's diet has been plugged in at the University of Ottawa's Health Sciences Centre.

The \$10,000 Nutrition Assessment System (NUTS) - the first to be installed in a Canadian university - should make diagnosing dietary needs and deficiencies much easier and more accurate, say university spokesmen. The nutrition program goes beyond current diet assessment techniques by examining 46 nutrients and ten amino acids in the average diet. Nutrition assessments are normally done by assigning a numerical value to various foods in one of four categories: protein, fat, carbohydrate and calories. The system, because it is only approximate, can be inaccurate up to a factor of 20 per cent. The NUTS system, now in use at one British Columbia hospital and one in Nova Scotia, takes about five minutes to make its 46-item assessment. University technicians said it would also be more effective because nutritionists can feed into it specific data not just about a person's eating habits but about the person himself. Statistics such as height, weight and muscle mass will be factored into the program to give a more realistic assessment of changes the subject needs in his diet. The system's first application will be with children prone to nutritional problems: burn victims, long-term head injury patients or children with cystic fibrosis. (Canada Weekly.)

Computer-tomography

A new portable computer-tomography unit helps determine the effect of high-voltage transmission lines and smoke from power stations on trees. The device takes X-ray pictures from many angles under microprocessor control to determine health, age and water distribution. Potential applications include checking wooden or concrete poles before maintenance people climb up them, determining if old buildings are still sound and data on climatic changes in previous years, and a new dating process for archeologists to use on wooden objects. (New Scientist, 3 July 1983.)

Computer-aided publishing

New computer-aided publishing (CAP) systems to be introduced in 1983 will allow operators to work with display screens that show text and graphics as they will appear in print. Most of the new systems are based on Motorola's 68000 microprocessor, graphics display controllers based on bit-slice processors and Bell Labs' Unix operating system. The systems depend on menus accessed by keyboard and by digitizing pads and a mouse. Most will use a local network to take inputs from word processors and text-entering terminals, line scanners and CAD systems and to feed phototypesetters, laser printers and electrostatic proofing printers. Laser printers make possible output of both text and graphic images. A drop in hardware costs has fostered development of the new systems, which require high resolution display screens. Bit-mapped display of 1-4 mil picture elements require vast amounts of processing power and memory to provide fast interactive screen updates. Specifications of several CAP systems are briefly discussed. (Technology Update, 14 May 1983.)

Computerized taxi-ordering system introduced in Gothenburg

Stockholm - A unique computerized system for taxi-ordering routines was recently put into operation in Gothenburg on the Swedish west coast. Called Taxi-80, it is claimed to clear the biggest bottleneck in the taxi sector - the telephone exchange which receives customers' orders - as well as cutting by 30 per cent the amount of time spent by taxis cruising without passengers.

Developed by Volvo Transportsystem AB, Gothenburg, and Ericsson Radio Systems AB, Stockholm, and ordered by taxi companies in Stockholm, Gothenburg and Malmö, which have invested about Kr.70 million (\$10,000,000) in the project, Taxi-80 consists of the following components: a telephone exchange, a computer system with a disc memory, a printer, terminals with keyboards, and, in the cars, a transmitter-receiver unit, a computerized control unit, an instrument panel, and a printer, the latter four items constituting a cassette.

Incoming taxi orders are recorded by a telephonist who communicates the customer's address to a computer via a terminal keyboard. The computer then consults a comprehensive address register for the relevant area code, after which it checks if there are any unengaged taxis in the district or immediate vicinity. If there are, this is displayed on the telephonist's terminal and the customer is informed that a taxi is on the way. At the same time, the first unengaged car in the taxi queue receives a written instruction on a paper roll from the computer with the customer's name, address and destination.

Thus, computer communication replaces voice transmission, allowing a much more effective utilization of radio channels. In addition, it is possible to continuously monitor the location of taxis and whether or not they are engaged. This is made possible by modern coding theory, micro- and minicomputers, the latter with large capacity and low costs, and printers suitable for mobile installation. (Science and Technology (Sweden), May 1983.)

COUNTRY REPORTS

Canada: Nova Scotia's microelectronics institute making waves

A new single side band radio has been designed that can store frequencies, operate on any one of those frequencies over great distances, and match the antenna with the chosen frequency. It can even transmit teletype messages. Design for portions of this radio is only one of the many ventures of the Applied Microelectronics Institute in Halifax, Nova Scotia. The institute, under the directorship of Dr. Douglas Pincock, is a self-funding, non-profit corporation bringing together the research and development expertise of its three founding institutions, the Technical University of Nova Scotia (TUNS), Dalhousie University and the Nova Scotia Research Foundation Corporation. Much of the work under way at AMI is marine-oriented. For example, an underwater information acquisition and control system

eliminates the need for heavy, expensive cables. The system provides for accurate surface monitoring of data from underwater sensors by means of a single wire. AMI has also developed techniques for the construction of small transmitters to attach to free swimming fish to monitor physiological and environmental data. AMI's research and development capabilities also include medical electronics. The large medical research establishment in Halifax has encouraged AMI to develop commercially exploitable medical instruments, such as a system for measuring blood flow using a miniature fibre optic catheter.

The Applied Microelectronics Institute opened in September of 1981. It has no plans to market its designs. According to Dr. Pincock, the institute's chief aim is to become a "centre of excellence" in the microelectronics field, leaving the marketing of its products to the business sector. (Canada Weekly, 23 February 1983.)

China spotlight on LSI assembly

The production of large-scale integrated circuit (LSI) devices is to be the immediate focus of China's electronic industry development, with particular emphasis being given to the establishment of two production bases, one centred on the Jiangsu-Shanghai-Zhejiang area, while the other combines the cities of Tianjin, Peking and Shenyang. Announcing the plans recently, vice-minister of the State Scientific and Technological Commission, Zhao Dongwu, stated that China will promote the all-round development of the LSI industry. This will include research and development, manufacturing, marketing and back-up services. The two new bases will serve as centres for the industry. According to Zhao, some technicians have been trained already and more than 40 types of LSI devices are already being produced. Basic materials are readily available. Advances have been made in China in basic theory and technology, though these will be supplemented by imported technology, Zhao said. Domestic demand for LSI devices in China is reported to be running at a high level presently. (Electronics Weekly, 3 May 1983.)

China prepares £20m high-tech shopping list

China is allocating £20m to buy minicomputers and microcomputers at the first Shunchun international exhibition which is being scheduled at short notice for September, according to the South China Morning Post.

Shenzhen (Shunchun) Hi Tech Expo '83 is being jointly organised by two Hongkong companies, SHK International Services Ltd, a subsidiary of Sun Hung Kai Securities Ltd, and Shen Ying Enterprises Ltd. In addition to computers, scientific and medical equipment will be displayed at the exhibition which is being promoted through the London and New York offices of SHK International Services as well as in Hongkong.

The company originally suggested February 1984 as the earliest date possible for the Shunchun exhibition. However, the newspaper said the Chinese officials were adamant that it be staged before 1 October, which is China's national day. The Morning Post said that at a meeting in Peking in the middle of May with Chinese officials concerned with computerisation, SHK International Services was led to understand that an allocation of HK\$200m (about £20m) had been made for minicomputer and microcomputer purchases at the exhibition. (Electronics Weekly, 3 May 1983.)

China develops special economic zone

The People's Republic of China is continuing to develop its Shenzhen Special Economic Zone, adjacent to Hong Kong. Most of the enterprises set up there are run by overseas Chinese. The first reported high-tech foreign investment will be in Shekou, a division of Shenzhen run by the Hong Kong-based, People's China-owned China Merchants Steam Navigation Company. Radofin Electronics, a Hong Kong firm 51%-owned by Britain's Fobel International, plans to invest \$9 million in a Shekou plant. The company has outgrown its 11-story Hong Kong plant, where it assembles a variety of products, including Mattel's Intellivision. (Fortune, 18 April 1983, as reprinted in Global Electronics Information Newsletter, April 1983.)

Computer boost to European integration

The goal of European integration may soon be a step closer thanks to the development of a new computer. An electronic problem solver able to cope with all nine languages of the European Community will be assembled over the next two years.

The European automatic translation system - 'Eurotra' - will have nine basic vocabularies, each consisting of 2,500 terms. The European Commission says it will be sufficiently mature for industrial production by 1988. (Outlook on Science Policy, April 1983.)

Is Europe going down the drain?

A hard-hitting report by two top economists to the European Parliament recently lashed out at the "tragic nature of Europe's poor performance in the field of information technology". The 130 page report, commissioned by the Parliament, was written by the right wing Principal of the London Business School, Professor James Ball, and the left wing French economist Michel Albert. Both agree that Europe is going the way of the Balkans after the first industrial revolution. They think that Europe is "slipping on the downward path of relative underdevelopment until ultimately it will be no more than a geographical expression". This is arising because Europe is not pooling its resources and is failing to respond to the challenge of what they call the third industrial revolution. Both Albert and Ball agree that Europe has to get its act together by encouraging high technology industries, ensuring European wide technical standards, and broad R&D programmes, as well as proposing a series of monetarist aims.

The European Parliament is likely to debate the report in September, and the document could influence future policy. Socialist Euro-MP Barry Seal has reservations: "It is an interesting academic exercise but probably won't be too effective as European countries now are working together less closely than in the past." Both authors point to the failure of R&D in new technology, which they believe has been "squandered" and concentrated in "yesterday's sectors". That is illustrated by Japan capturing 40% of the world microprocessor market between 1977-81 with an R&D budget of \$250 million for microprocessor development while Europe has only gained 10% of the market with a \$500 million budget. Pointing to Europe's \$10,000 million deficit in information and electronics 1982 trade balance, Albert calls for an increase in the community R&D budget to about \$20,000 million by 1983. He believes the current R&D programmes are inadequate: "The Esprit programme although a useful step in the right direction, is "ridiculously small", he said, "and if R&D continues to be organised at a national level it will become less and less competitive."

They both identified the vicious circle Europe is in. Europe is not manufacturing enough IT equipment and foreign imports are flooding in. The imports cause job gain in the US and in Japan, but job loss in Europe. Job loss drains Europe's resources and intensifies resistance to technological progress, and so on. (Computer Weekly, 21 July 1983.)

Electronic directories spread in France

More than 600,000 French homes will be equipped next year with "electronic telephone directories" - screen terminals which replace bulky paper volumes - under a crash programme announced by Minister for Telecommunications, Louis Mexandeau. Equipping homes in the Paris area will begin within a few months at a monthly installation rate of 15,000 terminals. FF1 billion will soon be invested in this nationwide programme annually. Mexandeau stressed that video terminals would be delivered only to telephone subscribers who opted for them. "There will be no compulsion," he said. The Minister added: "We don't want to develop this project in an authoritarian manner. We won't let market forces ride roughshod over citizens' wishes." The telecommunications ministry estimates that during the pilot trial in Brittany volunteers for installation of directory terminals have ranged from 40% to 80% according to areas. The database containing directory information for Brittany - both "white" and "yellow" pages - covers 1.2 million subscribers and permits 120 questions to be put simultaneously. The database will soon be accessible by 500 subscribers at any given moment. As the directory network spreads throughout France - with a target of covering all the country's 30 million subscribers - the government hopes that by 1990 the two groups will merge. Their association will also help to boost export prospects for electronic phone book technology. (Computer Weekly, 3 March 1983.)

French domestic market suffers as IT imports rise

France's information technology industry continues to lose ground on its domestic market to foreign competition as more and more French firms equip themselves with computer systems and peripherals, a major report has revealed in Paris. The National Association of Manufacturers of Computer Systems, Peripherals and Telematics applications says that although turnover rose by 28% last year to over 34 billion francs (\$3.1 billion) and one-third of production was exported, imports of office equipment increased by 27% and computers by 41%. Putting the spectacular growth of the domestic market into perspective the association's president Andre Riviere, former managing director of Cii-Honeywell Bull, said: "The dynamic performance of our market must be attributed to the need to make up time in introducing computer technology. We are still far behind our most advanced foreign partners in this field."

The association's report says: "The increased sales of foreign manufacturers reflects the inadequacies of our own national production in the fields of microcomputers and micro-systems, peripherals and office equipment." The report adds: "While exports have been picking up on the markets of our principal European partners where access was very difficult throughout 1982, the home market - particularly for small business customers, shows worrying symptoms of running out of steam. If this situation worsened, the situation would be serious."

President Riviere told Jean Claude Hirel, the French industry ministry's information technology chief, that the French computer industry was suffering from a shortage of engineers and technicians and the absence of genuine policy of industrial standards. Hirel replied that cash aid of various types will provide 1.3 billion francs (£120 million) to help develop new computer products and encourage the expansion of firms in the industry this year. (Computer Weekly, 21 July 1983.)

French developing submicrometer MOS technology

In progress at the Laboratoire d'Electronique et de Technologie de l'Informatique (LETI) in Grenoble is a research project that could liberate French integrated-circuit makers from dependence on US technology. It promises to furnish them with a completely French-developed 1-micrometer n-channel MOS technology that could be in full production by the end of 1984. LETI has already successfully produced test ICs in the technology and is optimizing it for transfer to manufacturers. Paving the way for future generations, the lab is shrinking the 1- μ m minimum dimensions to submicrometer geometry. It has already successfully produced MOS field-effect transistors with channel lengths as small as 0.15 μ m.

Although much of the process is proprietary, the structure is a rather standard n-MOS polysilicon gate. The breakthrough that made the small geometry possible was the development of a low-flux doping process, which permits surface annealing at a temperature of only 950°C, 100° lower than normal, and thus avoids unwanted diffusion and surface disruption. LETI hopes to reduce the annealing temperature by another 50° sometime next year. The rest of the technology is based on ultraviolet-source photolithography as well as a couple of dry-etching techniques-reactive-ion etching for polysilicon, silicon dioxide, and nitrides, and plasma etching for aluminium silicon and resist stripping. Using this technology, the lab has produced two chips so far - a 200-transistor ring oscillator with a propagation delay of 200 picoseconds and power dissipation 1.2 milliwatts, and a 200-transistor 3-bit adder for which the performance figures are proprietary. The yield achieved in producing these test parts was in the region of 80% to 90%. (Electronics, 15 December 1982.)

India

India is poised to become the first Third World country to develop and manufacture its own mainframe computer if a project now under consideration by the government Department of Electronics in Delhi goes ahead.

The state-owned Electronics Corporation of India hopes to run the operation from the development stage right through to manufacture and marketing. However, if the government has its way, a foreign company will be involved at least at the initial stages. International Business Machines (IBM), the multinational computer giant which five years ago pulled out of India after a row over local ownership laws, has shown interest in the project. Apart from the mainframe project, IBM is also tendering for a contract to computerize India's railway communications, worth \$US 250-million of hardware and software and consultancy services. (Soutn, April 1983.)

Computerised flood forecasting for Orissa (India)

A fool-proof device through computerisation for flood forecasting in the Mahanadi system in Orissa is sought to be employed in the context of repeated devastations in the river basin in recent years. A proposal to use the device awaits clearance from the Centre, according to official sources here. The Orissa Government is negotiating with the British Institute of Hydrology - a Government-sponsored organisation in the United Kingdom - who have agreed to entirely finance the scheme including supply of equipment, sources said. The scheme envisages installation of 16 unmanned rainfall river level recording stations, in addition to the existing 11 manned stations in the 80,000 square km catchment of the river including about 30,000 sq. km of the downstream catchment area.

These unmanned stations - eight to be located in the upstream catchment area (in Madhya Pradesh) and eight in the downstream - will automatically transmit data through radio to the Hirakud Dam control room at Burla. A microcomputer coupled with a trans-receiver installed in the control room will then analyse the data to predict the waterflow into the reservoir and in the downstream. A visual display screen will also show the hydrograph and a print-out obtained from the computer will provide all the intricate mathematical calculations. A monitor screen linked to the microcomputer at Burla, would be installed in the Irrigation and Power Department office at Bhubaneswar for reproducing the flood pictures of Hirakud and downstream for advance flood warning to the Mahanadi Delta areas. (Press Trust India, 31 July 1983.)

Italian CAD market growing

The Italian computer graphics market for CAD and CAE applications will reach \$110m by 1983, at an average compound annual growth rate of 43 per cent in the period 1981-1985, says a report by Reseau. The current market is estimated at \$50m. According to the report 600 CAD systems will be installed in 1985 in six industrial and two cartographic sectors which will be using 1500 work stations.

Japan builds a pillar of the fifth generation

A team of researchers at Japan's Institute for New Generation Computer Technology (ICOT) has just completed designs for one of the essential parts of the fifth generation project - the sequential inference machine (SIM). The team's leader, Dr. Shunichi Uchida, predicts that the hardware and "firmware" will be on show by late 1984.

Interference machines are one of the three pillars on which the concept of fifth generation computers is based. The others are knowledge-base machines and intelligent man-machine interfaces. While the knowledge base functions as a vast pool of information, the job of the inference machines is to work out solutions to problems. They will do this by working their way very rapidly through chains of simple logical inferences: for example, of the "if this is true, then that is also true" type. The goal is to raise the speed to millions of such inferences per second. Achieving this, however, will inevitably mean processing in parallel rather than in sequences. The parallel inference machine (PIM), one of the project's goals, is now in its basic research stage.

Uchida's team, however, is not immediately concerned with such leading research. Its aim was to make a small, relatively inexpensive computer to act as a research tool for the more rarified forms of programming to come. This initial incarnation of the SIM will be a sort of souped-up personal work station known as the personal sequential inference machine, or PSI. The machine architecture draws heavily on a variant of the logic programming language, PROLOG....

The system will store many basic functions such as the interpreter and the garbage collector (which gathers memory for reuse after the data it contains is no longer needed) in "firmware" - programs in read-only memory. Uchida's design for the PSI's hardware is mostly conventional. It sacrifices speed for size and cost, with a performance of about 20,000 logical instructions per second. This is slightly slower than the computer on which the team has done much of its simulation - Digital's DEC-2060. The most significant difference is the size of main memory: the 2060 has a total of 256 words (1 word = 36 bits), of which only 160,000 "words" are available for the user. Uchida feels that this is not enough and has incorporated a standard size of 1 to 2 million "words", expandable up to 16 million if 256 K rather than 64 K RAMs are used. To decrease access to memory, hence speed up processing, the processor module contains larger register files than usual, and the memory module contains two cache memories, whose access time is 200 nanoseconds, the system's clock cycle.

The languages are now ready for testing on simulators. Programmers have a challenging task ahead of them - no one has ever tried to write an operating system in a logic programming language before. And while the programmers get busy, the hardware specialists in the team will be seeing that the design is ready by next March. Then the plan is to demonstrate an operating program at the international fifth generation computer conference tentatively scheduled to be held in Tokyo in October 1984. (New Scientist, 7 July 1983.)

Malaysia

Electronics exports rose over 27% from 1981 to \$1.64 bil, mostly to the US. The exports are exceeding government forecasts and some manufacturers are operating at peak capacity to meet heavier demand. Most of the parts and products exported are made at least partly from imported parts, but 15-30% of the total export value represents value added to the goods locally. In 1982, slow markets and low prices limited total export growth to 5.3% and cut

earnings for every major commodity except timber and oil. Malaysia was left with a \$622 mil trade deficit and a record \$3.4 bil current account gap. Economic planners expect an 11.3% rise in exports in 1983, and the US market will be a critical factor in that projection. US firms invested \$400 mil in plants in Malaysia and Malaysian electronics exports to the US rose 29% in 1982 to \$1.22 bil. Semiconductor exports rose 18%, accounting for \$941 mil of the total. (Technology Update, 28 May 1983.)

UK

The Alvey Programme of collaborative research into advanced information technology, expected to cost £350m over five years, will go ahead - but no new government money will back the project. Patrick Jenkin, Secretary of State for industry, told the House of Commons that the government would fund just under 60 per cent of the programme from existing budgets. The Department of Industry will put up £110m and the Ministry of Defence £40m, while the Department of Education and Science will finance academic research through the Science and Engineering Research Council (SERC) to the tune of £50m. The remaining £150m will be found within the industry.

Although the Alvey Report recommended that research projects producing results which should be widely disseminated should be 90 per cent Government funded, while other work should receive 50 per cent funding, the Government has decided that all industrial work will be only 50 per cent Government backed. Jenkin said: "The key feature of the programme will be collaboration between companies, Government Research Establishments and academic institutions. Work carried out in academic institutions will as usual be funded 100 per cent by Government." "We have considered the Alvey recommendation closely, but have decided that 90 per cent Government funding does not secure a sufficient industrial commitment and could lead to the programme becoming divorced from industry's needs," he continued.

In line with the Alvey Committee proposals foreign multinationals will not necessarily be excluded from participation in the programme, which is designed to keep the UK abreast with its Japanese and US rivals, but their involvement will have to benefit UK industry exclusively. Jenkin commented: "We will require cast-iron assurances that work done here does not leak overseas to benefit the UK's competitors." The programme's concept, according to Jenkin is "to collaborate in the laboratory and compete in the market." Although MITI in Japan and the US government are spending substantially more money on research, the Secretary of State believes the programme is what industry wants. He added: "This is just the research end, vastly larger sums will have to be spent by industry in exploiting products."

The Alvey Programme will concentrate on the four technology areas set out in last year's Report - software engineering, very large scale integration, man-machine interfaces and fifth generation intelligent knowledge-based systems. The first projects are expected to be underway by the end of this summer. The Programme's five-man Directorate, headed by Brian Oakley, currently Secretary of SERC, will be a management body with no direct involvement in research. It will report to a supervising board of industrialists chaired on a part-time basis by Sir Robert Telford of GEC. (Electronics Weekly, 4 May 1983.)

Singapore

Singapore's quest to rival Japan in the information processing industry took a great leap forward last year with the establishment of Tata-Elxsi, a joint Indian-Californian-Singaporean venture which will be producing the Elxsi System 6400, one of the world's fastest and most modern multiprocessor computers.

Tata-Elxsi and Elxsi, California are unique in that they started as multinational corporations while their product was still in the research and development state. This is also the first time a high technology product is being introduced in the US and Asia simultaneously, before being marketed in Europe.

According to the managing director of Tata-Elxsi, the Californian company will provide the technology while the Tata Group is seconding technical and managerial personnel from India to run the Singapore company. Tata is also India's largest computer user with a large pool of experienced personnel in software development.

Tata-Elxsi has helped to develop sophisticated software enabling its computer in Singapore to communicate with the Elxsi computers in California. This was essential because software development was simultaneously being done at the two locations while the hardware architecture was being designed and implemented. Chandrahal claimed that the prototypes of the computer had been successfully tested at its Santa Clara base by Elxsi, California, and the computers are now being marketed. (Computer Weekly, 24 March 1983.)

Singapore

Hipro Engineering Ltd, a Singapore mould manufacturer, has successfully used computer-aided design technology to produce a computer keyboard mould in record time, the company has announced.

Since the Singapore-Japanese joint venture company started in mid-1982, the company has produced moulds for telephones, batteries, automobiles and hair dryers.

"The CAD-CAM system cuts down drastically on manual work, human error and production time. We were able to cut production time for a computer keyboard mould from five to six months down to two months. We plan to better this and do it in six weeks in future," Hipro's technical director K.W. Chong said recently. "With our CAD-CAM system and CNC machines, we are specialising in large moulds and precise moulds, for both of which we see a very good market in the Asian region." (Computer Weekly.)

National computer policy for Sri Lanka

The high-powered committee appointed by Sri Lanka President J.R. Jayawardene to spell out a national computer policy for Sri Lanka has recommended the setting up a National Computer Policy Advisory Council (COMPAC) and a Central Computer Secretariat (CECSEC).

The committee which was chaired by Dr. Mohan Munasinghe, senior energy advisor to the President, has also recommended that besides COMPAC and CECSEC, permanent committees of COMPAC on computer education, computer applications in the public sector telecommunications and data transmission be created to advise on and promote activities in these areas.

The island's universities, it says should be developed into centres of excellence with the setting up of a channel of communication with the Computer Society of Sri Lanka and other private special interest groups and companies.

It also emphasises the need for Sri Lanka to be self reliant as far as possible in computer skills, with a sound indigenous capability to evaluate and acquire foreign computer technology when necessary. The committee also considered the export of computer services, and urged high priority to improving infrastructural facilities that are essential for developing computer use in Sri Lanka.

While recommending immediate steps to improve computer-related skills and promote their application as widely as possible, specially in areas of scientific analysis, higher education, industry business and financial management and schools, the committee says that urgent efforts should also be made to ensure adequate financial incentives and job satisfaction, in order to attract and retain the services of computer personnel in Sri Lanka. (Computer Weekly.)

Zimbabwe's computer plans

The Zimbabwe Government will soon establish computer science departments in its training colleges, the Deputy Minister of Manpower Planning and Development, Jane Ngwenya, has said. Speaking at Harare Airport soon after the arrival of a four-tonne computer centre from Bulgaria, she said the equipment would augment "the limited and often stretched computer resources at hand". The primary objective of her Ministry was to develop skills in the computer field and to supply those computer centres already suffering from serious shortages of computer personnel at all levels with skilled cadres. The acquisition of the computer centre would not lead to duplication because the Government's long-time desire was to reduce the country's dependence on expatriate computer personnel.

"Our people should eventually be able to develop their own software through local innovation." Since independence, Zimbabwe had embarked on a massive programme of manpower development and training in all sectors of its economy.

"We firmly believe that in order for us to realise the Government's objectives to achieve self-sustained growth and economic independence in the shortest possible time, there is a great need to build a strong technological base. This can be achieved if we have the requisite technological skills." (Computer Weekly.)

COMPANY NEWS AND MARKET TRENDS

Inmos* in cash problems

Despite the 1982 Inmos loss of £20.3 million announced last week, new chairman Malcolm Wilcox is steadfastly optimistic about the company's profitability and cash requirements over the next year. Once Inmos has finished the Holy Grail-like search for profitability it will also have solved its funding problem. A company that can show it is profitable, or at least on the way to being so, is treated far more seriously than a venture which can only make projections. At this stage there is nothing to show that Inmos is actually on the way to profitability. Asked what tangible reasons he had for expecting a move into profitability next year, Wilcox said that market indications were good and that they had some interesting new products lined up. Inmos is basing all of its hopes on the move into volume production, but the real question is whether the leap in sales can so quickly produce the margins necessary for a move from a loss of £20.3 million into profit.

On a sales basis the 1982 performance is good, up from £2.14 million to £13.7 million, but the respective cost of producing those sales was £16.5 million and £10.9 million, leaving a gross loss on sales (without additional expenses) of £2.79 million in 1982 and £8.7 million in 1981. As managing director Richard Petritz points out, the 1982 increase in sales was achieved against a background of worldwide recession and stiff competition from the Japanese - in other words, getting higher sales often means taking less profit. The new financial year appears to have got off to a fair start on the sales front, with sales of £5 million in the first three months, which finance man Richard Hall says is ahead of plan, and he reports "a substantial booking rate". The total equity of the company in the 1982 balance sheet, before the last British Technology Group injection of £15 million, was £50 million with borrowing of £35 million, though there is some cash in hand to lessen this figure. This leaves the company very highly geared, and not attractive to the banks for new lending propositions. Out of that £50 million injected into the company, a loss of £42 million has been brought forward from the accumulated profit and loss account, leaving the balance sheet at the end of 1982 with a capital of only £8 million. So before the recent £15 million extra cash injection, the company was perilously undercapitalised. On the product front, Petritz was at pains to stress the uniqueness of the forthcoming 64K EEPROM operating on only 5V, which he says has been copied by the likes of Intel. He also reports a high level of interest in the OCCAM programming language, of which 200 kits have already been sold and, with all eyes on the fifth-generation computer, there are high hopes for the transputer. Petritz emphasised that the numerous start-up companies entering these markets do not have the technological and high-volume manufacturing of Inmos, leaving the company "well placed for a higher level of business". Looking at the present prices in the market, he said that prices have held up well for static RAMs in commercial and military markets, and prices in dynamic RAMs were beginning to firm. Another activity going on at the Inmos Bristol facility is the development of an integrated set of computer-based design aids for VLSI circuits to help in the constant goal of squeezing even more components on a chip. Six Inmos products have now been patented and Petritz says another 18 patents have been applied for. (Excerpted from an article by P. Robinson in Electronics Weekly, 20 April 1983.)

Inmos is all set for a Dram rise

Last year American suppliers of 64 K byte Dynamic RAM memories, the current staple memory of the microcomputer market and key product from Inmos, lost a collective \$125 million. This year, as the recovery continues in general economic trends, demand has enabled the Japanese, who are estimated to hold about 70% of the worldwide market in 64 K byte Drams, to shove prices up from \$3.50 to \$6. This same demand will enable Inmos to follow suit, increasing production and selling its products for a higher price.

The company is currently in the middle of the key ramp up into volume production of its 16 K byte and 64 K byte Dram. While Inmos benefits directly from the change in the fortunes of the semiconductor market, many of the US-based producers have been caught short of production, having failed to invest during the recession. This shortage, allied with the rise in price and demand, has created an opportunity for the UK government, looking for US investment to nudge the City of London into putting up private funds.

But there are some drawbacks a little further down the line. The experience of losses has persuaded a number of American memory chip producers to rejig their lines for a quick switch to the next generation of semiconductors, the 256 K byte chip. Leading the way, with prototype production now commenced, is an ex-team of Inmos designers, working at Micron in Bute, Idaho. Samples have already been despatched to various potential users, and Micron has

* UK's publicly backed semi-conductor firm; see also earlier issues of the Monitor.

licensed the product to a range of other semiconductor manufacturers. The biggest semiconductor giant of all, Western Electric, is already supplying volume 256 K byte products to its own units. And four major Japanese semiconductor giants, Fujitsu, Hitachi, Oki and Mitsubishi, are already supplying volume production of 256 K bytes chips to selected customers. A whole array of US companies, including Motorola, Intel and National Semiconductor, are poised to deliver by the year-end. (Computer Weekly, 21 July 1983.)

IBM buys a new friend to beat an old enemy

The faster an industry grows the more flat-footed the biggest companies feel in trying to stay ahead of competitors. IBM reigns over the world's computer industry, with sales last year of \$34.4 billion, pre-tax profits of \$7.9 billion and a research budget of \$3 billion. Yet it has still thought it necessary to pay \$228m for a 15% stake in Rolm, a nippy company making the private branch exchanges (pbxs) which link computers to telephones.

IBM has the money, manpower and knowhow to do most things that Rolm can do but it wants to stake in this comparatively small firm because

- Sales of small, personal computers are growing much faster than sales of the big central processing units that are the core of IBM's customary business.

- Office automation and hence demand for computers will soon depend on how easily equipment can be hooked up to communications network, so

- Telecommunications and computers are converging. An important test of how useful a computer will be is how easily it can communicate with other machines. But the industry's standards for connecting computers to telephone lines and other kinds of network are chaotic - a consequence of the number of competitors still jostling for a share of the market. IBM seems to believe that

- An alliance with a promising company making pbxs - even though the two firms have not yet agreed to develop or sell any products together - may ensure that whatever computers IBM makes will be compatible with Rolm-made pbx equipment. Rolm is the runner-up in this corner of the market to AT&T, IBM's arch-rival in the converging data processing and communications market.

IBM's purchase of a stake in Rolm is not just a pre-emptive move in the struggle to establish an industry standard for linking computers with telephone lines. It is also the latest in a series of such alliances which show that even the biggest computer company can no longer go it alone. Leading computer makers in each of the world's largest markets for data processing - IBM in America and in the rest of the world, Fujitsu in Japan, Siemens in West Germany, ICL in Britain - failed to foresee the sudden shift in the late 1970s from the use of centralised mainframe machines to small computers that could sit on every desk and communicate with each other. Entrepreneurial firms, with Apple in the lead, showed them the way.

IBM has been quickest to make up for lost time. It abandoned its policy of making everything in-house when it developed its personal computer: microprocessors were bought from Intel, software from the (then) tiny Microsoft. IBM also used outside distributors for the first time to sell its products. In the past 18 months, IBM has taken 20% of the American market for microcomputers, beating Apple into second place.

Now that it relies on outsiders for some supplies, IBM does not want to be left vulnerable. Hence the 12% stake that IBM bought in Intel last December for \$250m - the first such stake it had taken in another American firm. IBM wanted to support Intel, which was hurt by the recession in 1981 and 1982, and to help it meet Japanese competition. It is Intel's biggest customer.

The deal with Rolm will have to survive scrutiny by the justice department. Precedent favours IBM. Its decision to take a share of Intel met no objections from trustbusters: IBM promised not to raise its stake above 30% and to keep aloof from day-to-day operations.

The link with Rolm promises the big computer maker more say in setting an industry standard for the voice and data communications networks which plug office equipment together. About 40 companies are racing to develop computerised pbxs. AT&T is the one to beat and Rolm is the outstanding challenger in the pbx business. It has more than doubled its sales in the past three years to about \$500m a year. Several computer makers already have pacts with telecommunications companies to help them to develop data communication equipment: Hewlett-Packard and Data General both have links with Rolm and Northern Telecom.

Rolm is one of the few American firms which has tried to win a contract from Nippon Telegraph and Telephone in Japan; IBM's marketing power could now help it sell much more overseas. In return, Rolm's knowhow in pbxs could help IBM in Europe, where it is starting to push its personal computer. Office automation in Europe lags well behind the United States.

Though IBM's mainframe computer business still dwarfs other parts of the company, it now regards personal computers as its most important office automation product. In March it introduced an upgraded version of its personal computer range, the XT series, specifically designed for business use, while cutting the price of its existing range of personal computers.

The need to mass-produce these high-volume, low-cost products to keep up with fast growth in the market has persuaded IBM to look to other companies for ideas and supplies. When mainframe computers accounted for most of the growth in the data-processing market, IBM did not have to rush to introduce new products. And the cost of components mattered less in relatively low-volume, high value added production of big computers. The opposite is true in today's market.

The casualty in the new alliance between IBM and Rolm is Mitel, a Canadian manufacturer of pbxs. On June 13th, an agreement between IBM and Mitel, which envisaged that the smaller firm would help to develop equipment to link computers to telephone lines for sale under IBM's name, was scrapped. Mitel had fallen behind with development of its new pbx. IBM is not the only computer company disappointed by Mitel. Britain's resurrected computer firm ICL still hopes to use pbxs developed by the Canadian firm. (The Economist, 16 June 1983.)

Motorola in bubble venture

What both parties call a "long-term agreement" to co-operate in the development and production of bubble memories has been signed by Motorola Inc and Sagem of Paris. The first step in the agreement is for Sagem to produce and alternate source the 256Kbit and 1Mbit bubble memory devices which are proprietary designs of Motorola - respectively, the MEM2256 and MEM2011 memories. Sagem is to sample compatible parts in the fourth quarter of this year, and be in production in early 1984. The compatibility between the Motorola and Sagem parts will allow the use of the same peripheral support circuits - controller, sense amplifier, operation driver, and coil pre-driver. However, the French firm will sell bubble memory peripheral chips acquired from Motorola, at least for some time.

Future developments will come as part of the agreement, but Len Call, marketing manager for Motorola's bubble memory systems, would not elaborate beyond the initial step of alternate sourcing the current Motorola products. Sagem also had a bubble memory alternate sourcing agreement with National Semiconductor, as did Motorola. But there has been no agreement about bubbles between Sagem and Motorola until now. National dropped its bubble memory programme in the autumn of 1981, suddenly leaving the other two on their own. Sagem executives have made several visits to the US since the National termination, talking to National, Intel, and Motorola, as observers speculated whether bubble memories would ever find a viable market. That concern is no longer a problem, according to Call. He estimates that Motorola will in 1983 produce eight to 10 times the amount of bubble memories it did in 1982. This ramping up "is building to firm demand - not just for market anticipation," he says. Sagem is no newcomer to the bubble memory business, having developed its own technology and manufacturing process, starting in 1977. For more than a year, Sagem has made 256Kbit dies which were used in several Aerospace programmes in France. That firm had over 8,000 employees and sales of about Fr3bn in 1982. Motorola is also continuing the programme concerning its agreement with Intel, to develop and manufacture 1Mbit bubble memories based on the architecture of Intel's 7110 part. Motorola has shrunk the memory cell size of its 7110 equivalent down to 8-Microns, and will in the third quarter be offering that chip in Motorola's smaller leaded package. That circuit will have the same performance of the current 7110. By the end of 1983, Motorola is to make available a 7110 version, also in the small package, with twice the performance specs, based on the smaller die. That will have its field rate increased from 50KHz to 100KHz, access time reduced from 40ns to 20ns, and data rate increased from 100KHz to 200KB/sec. (Electronics Weekly, 18 May 1983.)

ICI in £10m science venture

The board of ICI, Britain's chief chemical company, has embarked on a big new venture to unearth or invent novel chemicals for the electronics industry, with the aim of taking a significant share in that industry's profits.

The company is committing £10m (\$16m) initially to a three-year experiment, with a commercial goal of creating a new £100m speciality chemicals business by the end of the decade. The new business venture, called the Electronics Group, is independent of ICI's operating divisions. It reports to Dr. Charles Reece, main board director, for research and technology. Dr. Reece says that initially the main markets will be Japan and the U.S., where the company is already discussing collaborations with electronics companies to invent the chemicals needed for big advances in electronics and information technology.

The electronics group does not include an estimated £30m business ICI is already doing with the electronics industry. This is chiefly in recording tapes, solvents and solder masks, where the company competes mainly on price. ICI puts the present world market for chemicals in electronics - a high growth industry - at £5bn.

According to McGraw Hill's trade journal, Chemical Week, the speciality chemicals needed by the industry can cost as much as £1,000 a gallon. The market has already attracted such names as Allied Chemical, Dupont, Eastman Kodak, Hoechst and Union Carbide. But ICI believes that, as yet, no one has a very large electronics chemical business.

Dr. Reece says the aim of the new venture will be "to advance technology by a big factor - not to compete on price". It means close collaboration with a customer to identify markets, he says. Dr. Reece believes the best opportunities lie at the man-machine interface: visual displays and printouts, for example. But he describes the industry as "highly fragmented and very fast moving", with life cycles for the final product as brief as three years.

The entrepreneur ICI has chosen for its new business venture is Mr. John Mellersh, formerly responsible for finding new business for ICI's organics division. The electronics group has set up office this month at Runcorn Heath, with a staff of 40. Mr. Mellersh says his group has access through an ICI data bank to 400,000 novel chemicals discovered by ICI scientists but never commercialised. (Financial Times, 31 May 1983.)

ICI pushes into the electronics sector

Imperial Chemical Industries (ICI) is spending \$3.1 million to acquire a new affiliate, IC Masks, to produce photomasks used in printing microchip integrated circuits. The move is part of ICI's effort to increase its involvement in the electronics industry. To further that aim, the company has set up a new unit, the Electronics Group, which will put strong emphasis on the manufacture of speciality components for the industry, in addition to chemicals. "We see the best benefits to be derived from integrating into the electronics industry," a company spokesman states. Initially, ICI is committing \$15.9 million to the Electronics Group to cover research and development expenditures, subject to regular review. Additional money will be spent, says the spokesman, on "acquisitions and investments as and when justified." By the end of the 1980s the company expects its business in this sector to reach \$160 million/year. (Chemical Week, 15 June 1983.)

SOFTWARE AND COMPUTER EDUCATION

Computer programmes go from arithmetic to calculus

Haven't you often wished that you could do six things at once? Computers are being developed to execute several instructions simultaneously. Success in cramming huge numbers of devices on to individual microchips - very large scale integration (VLSI) - has opened the way to such parallel-processing computers. However, making the most of the potential power and speed of such machines also depends on another development: the creation of new computer languages. Computer architectures and languages are intimately intertwined. Conventional (von Neumann) computers are, if you like, quick plodders. They move through a problem one step at a time in a strict sequence. And almost all computer languages used today reflect this fact.

The languages operate at different levels. Microcode is the most elemental language; sitting on the microchip itself, it instructs the chip's switches to switch on and off in the correct order to carry out a calculation. Next come the languages used in so-called operating systems (eg, Unix or, in the case of many microcomputers, CP/M) which mediate between microcode and applications programmes. These ensure that each instruction in the applications programme - and the data on which each is to operate - is shunted to the right chip at the right time in the correct order. At the top of the pyramid are the various languages - such as Basic, Cobol and Pascal - in which the applications programmes themselves

are written. Again, these are sequential; they comprise long lists of instructions built up step-by-step in strict order. Such computer languages have been enormously successful. But they have intrinsic weaknesses. Because programmes are built up step by step in a long chain of instructions, an error can be difficult to trace and onerous to correct: change one step and you may have to change all the following ones. The sheer complexity of sequential languages tends to make programming a black art with few generally applicable short-cut rules. Worse, by their very nature, such languages are not geared to instructing a computer to do several jobs at once.

Much effort is therefore going into the development of new languages, called declarative languages, that avoid these weaknesses. Three examples of declarative languages are Lisp, Prolog and a language being developed at London's Imperial College called Hope. In essence, such languages break down a complicated problem into a series of shorter, simpler ones - each of which can be worked on independently, and therefore simultaneously, by different processing chips in a computer.

To understand, consider a very simple example. Suppose you wanted a computer to add up six columns of figures and multiply them together. Using a conventional programming language and a conventional computer, you would have to instruct the computer to:

- (1) Add the figures in the first column and store the sum in memory;
- (2) Add the figures in the second column and store;
- (3) Add the figures in column three and store;...
- (7) Retrieve sums 1-6 from memory and multiply.

Using a declarative language and a parallel processing computer, you might write something like:

- (1) Processors A, B, C, D, E and F respectively, add the figures in columns 1-6;
- (2) Multiply sums 1-6.

Obviously, the second approach is neater and speedier.

There are less obvious advantages to declarative languages - for which it is difficult to give such simple examples. In effect, whereas conventional computer languages are geared to the step-by-step logic of simple arithmetic, declarative languages have the power of more complex maths, like calculus. Such a "programming calculus" can follow a clear set of rules. And that, in turn, means that programmes are not only easier to write but also to "debug" and maintain. For instance, in the example given above, if you had mistakenly written "subtract" instead of "add", a single correction would put all six processors on the right track. Declarative programmes would even lend themselves to a degree of automation. Do not expect declarative languages to replace conventional ones rapidly, however. For one thing, there is a huge investment in sequential languages: in software, in programmers and in user familiarity. The installed base of software on IBM computers alone is crudely estimated to be worth \$300 billion.

For another thing, parallel-processing computers themselves are only at the early development stage. And the declarative languages themselves are still adolescent - with vocabularies to match. (The Economist, 28 May 1983.)

Problem solver

An American company that has sold 400,000 copies of a microcomputer program for producing company budgets hopes to do the same with a second program that turns microcomputers into all-purpose calculating machines. Software Arts has produced software which takes care of calculations commonly carried out by scientists, engineers, architects and financiers.

The program, designed to work on the IBM Personal Computer, is called TK! Solver (TK stands for Tool Kit). Software Arts spent over three years designing it.

TK!Solver contains a number of common formulae and relationships, for example: linear equations, simultaneous equations, sine, cosine and net present value. As with the firm's Visicalc business program, someone using TK!Solver types in the rules that are to be applied to a problem and known variables. The program then performs the calculation.

Software Arts has produced a number of extra programs which sit on top of the basic TKISolver and which are designed for use by particular professions. So far Marketing Micro software, the company distributing TKISolver in Britain, has introduced two applications packages: for mechanical engineers and financial people. It says it will soon be selling programs for architects, builders, aerospace engineers and nuclear physicists. (New Scientist, 7 July 1983.)

British software

Sales of software in Britain in 1981 (according to the latest estimates from the consultancy outfit Quantum Science) were \$1.5 billion. This compares with \$8.3 billion in western Europe as a whole and \$22 billion in the United States. Software sales in Britain and the rest of western Europe are growing by 15% or so a year but this is a figure that conceals as much as it reveals. Some parts of the business are expanding quicker than that.

Software companies sell computer processing services, tailor-made ("custom") software and packages of software used by a lot of customers to do a standard task like accounting or totting up how lawyers spend their time. Many British software firms started out in the business 15 or more years ago selling number-crunching services (eg, payroll calculations and accounting) to companies that could not afford their own computers. Data processing still accounts for half the industry's revenues. Scicon, a subsidiary of BP, is the biggest British data processor, though it is dwarfed in international markets by companies such as IBM, General Electric and Comshare.

Small, cheap computers have already spiked growth in data processing. Sales of these services in Britain grew by a mere 6% in 1981 and probably not at all last year. (The Economist, 26 March 1983.)

Artificial Intelligence in molecular biology

One of the hottest areas in artificial intelligence research is that of knowledge-based or expert computer programs. Stored in the computer is the accumulated wisdom of the "experts" in a certain field. The program can use this information to make deductions concerning data entered into the computer. The best known of these are medical diagnosis programs. A patient's symptoms are entered, and the program "asks" a series of increasingly specific questions whose answers enable the program to conclude the most likely cause of the patient's distress.

Molecular Design Ltd. of Hayward, California, has used this strategy in its database management system for molecular structures and chemical reactions. One program called MACCS for molecular access system allows the user to store and retrieve molecular structure information. One way to access the stored information is to draw on a special graphics tablet a sketch of a molecule or a part of one. The program contains information about the rules of molecular structure and can "clean up" the sketch, after which it searches the database for the molecule or for all larger molecules of which it is a part. A similar capability resides in a program named REACCS for reaction access system. Reactions encountered in the laboratory or in the literature make up the database that contain a specific molecular substructure graphically entered on the graphic tablet.

GENOA is a program that finds all the molecular structures allowed for a particular molecular formula entered by the operator that are consistent with certain constraints, also entered by the operator. The structural candidates are displayed on a video screen and may be entered into the MACCS database. GENOA is an elaboration of an expert program named DENDRAL that was written by artificial intelligence researchers at Stanford University to deduce molecular structures from mass spectrometry data. DENDRAL's knowledge base consisted of rules for deriving constraints on molecular structure from experimental data, a procedure for generating candidate structures that satisfied the constraints, and rules for predicting mass spectrograms from the proposed structures.

A fourth program, ADAPT, allows the determination of structure-activity relationships by the use of pattern recognition and other statistical techniques. In one study at Pennsylvania State University on the carcinogenicity of nitrosamines, researchers using ADAPT were able to find 22 structural descriptors that provided the ability to determine which molecules were and which were not carcinogenic.

The Molecular Data programs are designed to run on "mid-sized" machines with the considerable computing power needed for their execution. Prices range from \$100,000 to \$150,000 subject to the specific needs of the purchaser. (Science, 8 April 1983.)

CAD/CAM

A European computer market forecast by International Data Corporation (IDC) clearly indicates that at present there is a low usage of Computer Aided Design/Computer Aided Manufacture (CAD/CAM) among manufacturers, even in those industries most likely to benefit from its introduction. The table below lists the five most likely manufacturing industry sectors to benefit from CAD/CAM usage and shows the percentage usage in each country. Although the sample sizes are small, the results show that only 16% of companies in the engineering and car and aerospace industries currently use such systems. Furthermore there is a tendency for such users to be larger companies. Out of 18 CAD/CAM users, 13 of them (72%) employed more than 500 people.

These results correspond closely to recent government studies on the use of CAD/CAM in industry (in the UK). These studies also noted a generally low usage and a tendency towards larger companies, despite the availability of CAD/CAM systems which can run on minicomputers and which are within the budget of medium sized companies.

The problem according to IDC is making the smaller companies aware of the advantages CAD/CAM can offer them. One government reports states: "Any difficulty in implementation concerns not the inherent technical capabilities of the system but rather the information gap that has to be bridged in order to make companies aware of what CAD/CAM systems can offer and the effort required to tailor commercial systems to firms' individual requirements."

Hence there is a clear challenge and opportunity here for vendors of CAD/CAM systems to educate and inform prospective clients about the advantages of their particular product and to tailor those systems to user requirements, concludes IDC. The cost of minicomputer based CAD systems range from \$125,000 to \$600,000. Added OEM value typically includes the design and manufacture of tablets, digitisers, plotters, graphics terminals, workstation and peripheral controllers and software. Hardware accounts for 90% of the cost of a CAD system, software only 10%. Workstation peripherals, including terminals and tablets, represent the largest share of hardware costs, followed by system-level peripherals like disc and tape drives, printers, plotters and digitisers. The processor, including main memory, represents the smallest portion of hardware costs, says IDC.

The rapid growth in the CAD market has been fuelled by the development of the three-dimensional modelling software required for mechanical design applications. This market has been slower to develop partly because of the complex calculations required to manipulate 3D figures on the screen. However, the design economies associated with CAD systems for mechanical design appear to be much greater, and the total market potential much larger, than for electronic design applications. Processing speed and memory capacity are the major factors considered by users when selecting CAD systems. And 32-bit processors are attractive as they allow the system to define the coordinates of points on the screen with high precision, and to perform complex rotational calculations without losing accuracy. They can also support the heavy computational throughput required for these calculations. CAD suppliers generally develop standard software packages for use with their systems; little or no customisation is done for individual customers, says IDC.

Portion of CAD/CAM users in different manufacturing industries

Industry	CAD/CAM users	%
Chemicals	1	6
Fabricated metal	3	21
Mechanical machinery	6	15
Electronic machinery	5	23
Transportation equipment	1	10
Subtotal	16	16
Other	2	2
TOTAL	18	9

(Computer Weekly)

Computer Graphics

A witness, who has had only a glimpse of a criminal, describes some of the criminal's distinctive features. He watches as his piecemeal descriptions get converted and shown to him as a human face on a TV screen. On the basis of this picture, he starts recollecting more, and either modifies the described features or adds more features till he is reasonably satisfied.

Again, a mechanical engineer who wants to produce an intricately shaped metal part on a computer-controlled milling machine would begin by describing the part to a general-purpose computer, which draws a picture of the part. The engineer can now verify whether or not the description is accurate. Both these are examples of people who have a pictorial problem in their work and for which they would like computer aid.

Similar pictorial problems, in which computer graphics can help, arise in most branches of engineering - architecture, automobile, aircraft, civil, electrical, chemical, electronics, highway planning, ship-building, cartography, etc. - and in graphic design applications such as TV and animated films, textile patterns, graphic arts, business presentations and publications etc, where written language is far from adequate.

Computer graphics has also become a major importance to another group of people - those who use it as one of the many tools for imparting or gaining deeper understanding of a problem - for gaining insight into complex natural or mathematical phenomena. These people simulate situations of various kinds in the computer and use computer-controlled graphic display devices to present the results of the problem. Some examples of these:

An organic chemist can create a picture on a computer-controlled TV screen of a molecule he plans to synthesise. He can then initiate a program by which the computer presents a selection of simpler molecules, from which the desired substance can be synthesised. A physician, in order to diagnose the cause of an ailment, can x-ray scan his patient's head and obtain a 3-dimensional shaded display of a portion of the head. The display is, again, flashed on a computer-controlled TV screen. A physics teacher can program his computer to illustrate how elementary particles interact with their own electric fields to give his students some feel of quantum mechanical behaviour. (Science Today, India, January 1983.)

'Pirate proof' software

Wiltshire software house Parwest is to go into micro software rentals, using a new technique to ward off pirates. The system works by forcing users to phone the supplier at random intervals to get a number which enables them to carry on. "It's a never-ending sequence so that the same number does not recur," explained managing director Keith Park. "The user gets a warning flashed on his screen and then he has maybe three days' grace in which to get in touch. After that he gets locked out." (Computer Weekly, 7 April 1983.)

Lloyd's covers the crime rate

A growing computer crime rate has led to a complete rewrite of the Lloyd's electronic and computer crime insurance policy, introduced just a year ago. At the same time the policy has been extended from banks to any commercial user. The policy covers fraudulent input of data to systems run by a company or a bureau it is using, plus the changing, destruction or theft of data. Fraudulent changes to programs are also included. On the communications front the policy covers the input of data into electronic funds transfer systems, including networks of point-of-sale terminals or automated teller machines, as well as losses from fraudulent instructions sent to or from a clearing house through public networks such as telex or the international Swift funds transfer network. Even false instructions made by telephone are covered.

Existing insurance protects companies against fraud by staff - and insiders are almost always involved, according to Mike Wood, privacy and security consultant at the National Computing Centre. "Tampering with input is the most common way of committing fraud, mainly because it's far easier than changing a program or files," Wood said. "US figures show that 90% of cases involve manipulation of input or output. There is now little evidence of interference on communications lines and there is a lot of activity among users on encryption." Wood said the computer crime rate was clearly growing, if only because the number of systems was increasing. There were more prosecutions than ever before. But it was difficult to talk of statistics because government crime figures did not have computer crime category. There were 100,000 fraud cases a year and many of them would now involve computing, Wood said. A survey at the end of 1981 showed that of the 350 organisations replying, 69 admitted to having suffered from computer crime. The total loss was less than £1m. (Computer Weekly, 24 February 1983.)

Women-only micro centre

Leeds has opened the largest women-only micro training centre in the UK with creche facilities. It is the second women-only training centre. About 60 women will attend two basic year-long courses in computing and microelectronics each year and a further 120 are expected to join eight advanced courses lasting six weeks. The eight lecturers appointed so far are all women. The courses will teach programming languages, circuit building, and electronic equipment testing, and on the basic courses the women will work in local companies for two months.

Leeds City Council is paying £453,000 towards the scheme, and a European Community source, the European Social Fund, is contributing £226,000 for the first full year.

The courses are to be held in the re-opened Sweet Street Skills Centre, which was a training centre for heavy engineering before it was closed in 1979. The Centre will also accommodate a series of mixed six-week training courses for field service engineers and a new Department of Industry-funded Information Technology Centre (ITEC).

Councillor John Battle of Leeds City Council: "The traditional industries, manufacturing and clothing, were geared to women, so unemployment among women is high. We now want to train women for the computer world."

The Department of the Environment contributed £175,000 towards the capital cost of the Centre as part of its Inner City Development Programme. The ITEC has been held up while the manpower Service Commission and the Department of Industry decide on its precise funding.

The hold-up is that ITEC centres usually accommodate about 30 teenage trainees, whereas Leeds City Council wants to cater for up to 80. The Council is confident that it will receive about £110,000 from the Department of Industry by the summer. (Computer Weekly, 24 March 1983.)

Micros for the masses

BBC presenter Brian Redhead is already famous for his television series which tried to bring the micro to the business masses. He has now chosen to exploit his talent for jargon-free exposition with the launch of a video called The Micro-Computer in co-operation with BBC Radio 4 producer Trevor Taylor, and the National Computing Centre.

"The aim is to make the micro palatable to a larger audience," insists Redhead. "We use as little jargon as possible, define what few terms you need, and stick to them." Terms evoked by Redhead in the introductory video to what promises to be a refreshingly down-to-earth series include "software", "byte" and "floppy". Future videos in the series will cover more specialist topics like database software, word processing and accounting.

A later series may introduce sophisticated notions like networking. The emphasis will be on software, insists Redhead. The introductory video includes an exhortation to buy existing software packages rather than try to reinvent the abacus. "The Micro-Computer" costs £29.90 plus £1.75 carriage and insurance from Double Tee Productions of London. (Computer Weekly, 21 July 1983.)

ROBOTICS

Survey of the robot industry

The robot industry is heading for a shake-out. Though its markets are growing as fast as any sunrise industry, the number of companies that want to sell robots is growing even faster. Despite worldwide growth in robot sales of some 30% a year, big Japanese robot makers are cutting production. A few small American and European firms have gone out of business. With so many giants jumping in, the market is becoming overcrowded, even in America where robot sales this year are expected to reach about \$240m. The competitors include Westinghouse, General Electric, IBM, United Technologies, General Motors, Cincinnati Milacron and scores of smaller American firms - plus foreign heavyweights like Sweden's Asea, Japan's Hitachi and Fujitsu-Fanuc, Volkswagen in West Germany and Renault in France. Robot markets are overpopulated elsewhere. In Britain 40-50 firms are vying to sell robots.

Others are signing agreements to license other firm's robot technology or developing their own products. Prospects for newcomers seem bleak. About five established companies will probably sell three quarters of the 400 or so robots British manufactureres are likely to buy this year. Even the market leaders will find it tough to make enough money to cover development costs. Most firms making robots will lose money in them for the next few years. The big companies have the financial fat to absorb years of losses on robots, and to buy up small robot makers as Westinghouse did recently when it bought Unimation, the world's leading producer. They will use it. With few exceptions, most of the large firms already in the robot market seem determined to stay there. They want (eventually) to profit from expanding robot sales; to use robots as a way into other automation markets, like computer-aided design and computer controls for machine tools; and to service robots already installed. All the big firms in the robot business have international sales and servicing networks. They can afford to reinforce them with trained staff. But their biggest advantage is the experience they have gained in putting robots to work in their own factories.

The basic technology of robots is now fairly well established. They are simply mechanical arms which can repeat a simple series of motions guided by a computer. Unless a firm comes up with an innovation which suddenly makes all existing robots obsolete (unlikely), the key to competition in robots is experience in teaching innately stupid machines to do ever more complex tasks.

So far, robot sales have grown largely on the strength of relatively simple applications like spot-welding and paint-spraying. Carmakers were the big market. But some carmakers are now supplying their own robots, including General Motors (through a licensing agreement with Japan's Fanuc), Renault and Volkswagen (which has licensed its robots to General Electric for sale in America). Many robot makers now reckon that the best prospects for growth lie elsewhere - in just the sorts of tricky manufacturing jobs that companies like IBM, General Electric and Westinghouse have struggled to teach their own robots to tackle. General Electric, for example, already has over 500 robots working in its factories, roughly 8% of America's total robot population. Some small firms are ready to surrender. After Westinghouse bought Unimation, it was approached by several firms that wanted to be acquired. Others are sustained by investors willing to take big risks. But the only safe niche left for small firms is the high-technology end of the robot business, which includes:

- Arc welding. To tap this market, companies have to teach the robot's welding arm to follow the seam where two pieces of metal meet. Unimation has developed its own way of doing this job. Cincinnati Milacron has licensed its system from CRL Welding, a small company in Tennessee.

- Automated inspection. If robot arms are to do the job of checking the workings of manufactured components, there is room for a variety of suppliers to work out clever new sensors and computer programmes. British Leyland has developed a new way of using robots to test the seals on car bodies. A variety of other small firms are hustling into the market. Westinghouse is thinking of buying its way in.

- Assembly. Many reckon that the biggest job for robots will eventually be putting together manufactured components into finished products. But to tap that market robots will first have to learn how to "see" and react better to their environment. Among recent entries to this market is Intellex, based in Oregon and begun by a group which left Hewlett-Packard to develop a camera-guided robot capable of inserting fragile microchips in circuit boards. Small firms are competing well in the race for a successful robot vision system. Small American companies whose robot vision systems are already used by big ones include Machine Intelligence Corporation and Automatix. (The Economist, 4 June 1983.)

Japanese robot output to soar

Japanese production of industrial robots will average a growth rate of more than 30 per cent per year over the next three years, says a market study published by the Venture Development Corporation. In a report, *The Japanese Robot Industry: A Strategic Analysis*, a number of factors promoting this rapid expansion are identified. These include advances in robot technology, socio-economic and demographic factors, as well as certain policies of the Japanese government.

Substantial advances have been achieved in the reliability of industrial robots produced in Japan. In 1968/1969, the mean time before failure (MTBF) averaged only about 150 hours. At present, MTBF averages about 1,000 to 1,500 hours. This dramatic improvement in reliability has promoted Japanese demand by greatly improving the reputation of industrial robots among users.

Together with higher reliability, technology advances have consistently reduced the price of industrial robots relative to Japanese labour costs. The 1970s saw a continuous decline in the ratio of the average cost of a playback robot to the average cost of labour in manufacturing. The present ratio of about 3-to-1 based on singleshift operation is actually much more favourable considering that industrial robots can be used around the clock.

In addition, technological advances have greatly broadened the range of industrial robot applications in recent years, through increased speed and precision, lighter weight and smaller size. Substantial improvements in memory capacity and control mechanisms have been realised, allowing for a greater variety of improved functional capabilities.

Due to the slower economic growth of the 1970s, specially after the first oil crisis, Japanese manufacturers came under increasing pressure to cut costs. This is suggested by the fact that about 90 per cent of Japan's robotics producers initially developed industrial robots in order to automate their own production lines.

Growing demands for improving safety and quality of the workplace also stimulated demand for industrial robots. Historically, most industrial robots were first installed for hazardous and unpleasant work processes, such as welding, spray painting, pressing, and plastic molding. Thus, these areas have a relatively greater degree of ownership than other application areas.

Then, too, the Japanese manufacturing sector has responded to slower economic growth, increased competition, and changes in consumer demand with a greater portion of small lot production and more frequent model changes. This trend has stimulated demand for more sophisticated robots which can be readily adapted to new production requirements because of their reprogrammability.

Japan's labour situation has also contributed to the growing demand for factory automation, including robots. The 1970s saw general stagnation in the growth of the Japanese economy as a whole. Aging of the Japanese work force, coupled with the higher educational attainment of Japanese youth, has led to shortages of skilled and blue collar labour.

By occupation there is unmet demand for machinists, welders, and painters - the main areas where industrial robots have been introduced. These labour shortages are particularly acute for small and medium-sized firms, which are at a disadvantage in competing with large firms for scarce labour. (Electronics Weekly, 6 July 1983.)

Robot manufacture in Japan

Japan's Ministry of International Trade and Industry (MITI) will start spending in 1983 \$70 million on a seven-year project to develop "learning robots" for sea-bid and space exploration, nuclear research and power-plant maintenance as well as aids for the old and handicapped. The project is headed by the ministry's Electrochemical Laboratory and involves about 10 major robot, computer and machinery manufactures. The first two generations of robots and their technologies were developed largely in the US by organizations like MIT and Unimation Inc. Japan seems to have a special advantage in robotics today because so many firms there are both large users and makers of robots.

Among the world's leading users of robots are Japan's giant electronic, electrical and mechanical appliance firms. They excel at the skills central to robotics. Hitachi, Toshiba, Mitsubishi, Fujitsu, Nippon Electrics and Matsushita - the largest of the "mech-tronics" groups - began making robots as long as a decade ago. In the past year or so they have launched major design and marketing efforts for factory automation systems.

Hitachi ranked in 1981 as Japan's second biggest robot manufacturer (behind Yasukawa and ahead of Kawasaki Heavy Industries). It began making robots in 1970 for itself: in 1975 it started selling arc-welding units equipped with sensors.

Twenty company divisions for electrical machinery, computers, communications, measuring instruments and systems engineering all co-operate in robotics work. Ten company factories are used as model automation plants.

Toshiba is Japan's second largest maker of general electrical machinery and appliances. It specialises in spotwelding and fixed-sequence robots, but will soon market arc-welding machines and robots that can pick up items such as lumps of metal.

Mitsubishi Electric has a special "industrial mecha-tronics division". It makes arc-welding and educational "hobby" robots as well as transport, assembly and materials handling robots equipped with sensors and laser navigation devices. Mitsubishi Heavy Industries and Mitsubishi Metals are also large users and makers of robots and other factory automation systems.

Fujitsu is Japan's biggest manufacturer of mainframe computers and is a leader in office automation equipment. This firm has been designing precision assembly robots to make integrated circuits for the past decade. It expects to sell, in two or three years, intelligent robots capable of limited judgement.

Fujitsu-Fanuc, a robotics firm within the group, is the world's top maker of numerical control equipment. Last June it established a venture with General Motors in the US to build robots for the American market, including GM's plants. Fanuc is also developing intelligent robots with Siemens of West Germany.

Fuji Electric, the oldest company in the group, specialises in heavy machinery and semiconductors. It first produced robots - "electric hands" - in 1971; more recently the firm designed "intelligent inspection systems" that combine video-sensors with the world of machine tools.

Nippon Electric has 10 years' experience in making numerical control equipment and computerised design and manufacturing systems. In 1981 it launched one of Japan's most precise assembly robots, capable of inserting objects into 0.5mm-diameter holes and of performing delicate laser welding. Nippon is Japan's largest manufacturer of integrated circuits and office automation equipment. Last year, for the first time, it produced more computers than Hitachi, and took second place in the field to Fujitsu.

Matsushita Electrical Industrial is the world's largest maker of electric appliances and video tape recorders as well as one of the biggest users of assembly robots. The group makes much of its own mass-production equipment, including robots that assemble electronic circuitry, multi-arm welders, automatic laser machine tools and screw fastening robots. Matsushita now intends to develop intelligent robots that will combine the technology from office automation, microcomputer and video disc systems.

Although plant automation is the primary interest of the "mech-tronics" firms and most other robot makers, the Japanese have many uses for robots outside the factory. Several of these applications, such as nuclear power-plant maintenance, are designated for development in the MITI project. Six of Japan's 10 electric-power companies are cooperating with Hitachi and Toshiba (the country's biggest nuclear power-plant makers) to automate dangerous work.

The joint effort has produced remote control fuel-rod exchangers and automatic inspection systems for radio-active welded pipes. Future work will specialise in automating floor decontamination, inspection and reassembly of steam safety valves and taking samples after accidents. Inspection and monitoring are expected to be done by mobile robots capable of pattern recognition.

Meidensha, a control equipment and transformer maker in the Sumitomo group, has built pressure sensors, said to "approach the sensitivity of human fingers", into robots for nuclear plants.

The Japanese would like to automate mining. The most advanced equipment in use is for coal transport. It uses television cameras on coal cars. A system is being considered that would place shield-type support beams in front of a drum cutter opening up tunnels while being operated 10-20 metres behind.

Another technology being explored is sea-bed robotics. Komatsu has built a robot with eight "legs" that move four at a time to propel the machine at 200 metres per hour regardless of obstacles. The cable-controlled unit, which is lowered from a ship, carries equipment such as TV cameras and sonar. The Komatsu robot was designed to help draw detailed maps of the ocean floor but it may serve as a prototype for mining and construction vehicles. ... (New Scientist, 6 January 1983.)

Robot threat to Japanese industrial harmony

The traditional harmony of Japanese industrial relations is under threat as more workers begin to fear that the rapid expansion in the number of robots is threatening their guarantee of 'lifetime employment'.

At the forefront of the dispute is the Japanese Automobile Workers' Union (JAWU). They have concluded a first 'robot agreement' with Nissan Motors Corporation, Japan's biggest single robot user. Now the introduction of new technology is subject to 'prior consultation', no union members must be fired, laid off, or suffer demotion or cutbacks in wages or living standards.

The General Council of Trade Unions of Japan (SOHYO) sees the biggest problem as non-union enterprises where there is no policy of retraining workers. Opposition parties want to see robot taxes on profits brought about by increased productivity with robots to pay for workers' pensions.

With 13,000 employed in 1982, Japan had more robots than any other industrialised nation. The annual British Robot Association census shows the USA second (6,250), followed by West Germany (3,500), Sweden (1,300), Britain (1,152), France (950) and Italy (700). But Sweden leads on the basis of robots per working population. (Outlook on Science Policy, April 1983.)

Robot research centre

Japan's leading specialist maker of robots, Dainichi Kiko, is looking for foreign brains. The company plans to build a research centre manned by both Japanese and Westerners to meet the demand for new types of robot.

This month, work is due to begin on a 60,000-square metre site in Yamanashi, west of Tokyo for the new research and development centre. It should open in 1985. Meanwhile, the company plans to hire about 50 researchers, of whom 20 will be foreigners. Dainichi already exports 40 per cent of its robots, so Western recruits will probably come from companies with which it has connections.

Dainichi's president, Toshio Kohno, says the new centre will develop robots for work in new areas, such as automating offices and shops - and even as waiters in restaurants. (New Scientist, 23 June 1983.)

Robotics in brief (as published in "Technology Update")

Ford Motor plans varied use of robots. A project under way at Ford's new Robotics & Automation Application Consulting Center (Dearborn, Mich) is development of a robotic adhesive application system for polystyrene foam patterns to be used in a new casting process. Ford also wants to use robots to assemble auto heater blower motors, an application requiring high accuracies and tight control at the end effector. Ford is also evaluating robots as assembly devices for alternators; as spot welding devices for the body sides for medium and heavy duty trucks; as an automatic means of installing spark plugs into engines on the production line; and for use in producing ignition coils on a manufacturing line that uses preheaters, conveyors, epoxy machines and equipment. There are now 20 robots from US and overseas suppliers in the center, which is large enough for tryouts of peripheral equipment such as parts handling and feeding mechanisms, grippers, conveyors and fixturing devices. (Am Mtl Mkt, 13 December 1982.)

Robots to work in mines, reactors and tunnels are being developed at the edge of automation technology. At Carnegie Mellon University, a state-university-industry study on using robots in coal mining is under way, with some controversy over the possible loss of jobs. In Japan, MITI has launched a 7-yr, \$63 million program to develop mobile robots with humanlike senses. As early as summer 1983, Automax (Japan) will begin selling a non-manufacturing robot to clean the inside of oil tanks. While the Japanese add sensors and intelligence to a conventional piece of machinery, US development aims to design robots specifically for the task, such as the bricklaying robot developed by CMU researchers. (Bus Week, 24 January 1983.)

Flexible Manufacturing Systems (FMS) have far-reaching repercussions in manufacturing strategy, along with their benefits of productivity gains, asset utilization rates, production flexibility and savings and capital investment and plant size. As batch production for low-volume models in small market segments becomes more important, the 'economy of scope' of flexible automation will allow manufacturers to become more competitive. The US is the world leader in flexible manufacturing systems, but most of the action is now in Japan which is installing it faster. Several examples of showcase automotive factories are cited, with the most astonishing being one to be started up in March 1983 by Yamazaki Machinery Works

near Nagoya, where 65 computer-controlled machine tools and 34 robots will be linked via a fiber-optic cable with a computerized design center in headquarters, 20 min away. At maximum capacity, the plant will turn out \$230 mil/yr without laying off workers, if need be. In all, 215 workers will be used to help produce what would take 2,500 in a conventional factory.

In the US, General Electric, Ford and GM are moving to take advantage of FMS. Flexible automation may not be the threat to jobs that is feared, as the US faces a shortage of skilled machinists through the 1980s, and because automation of assembly, where semiskilled jobs are found, will proceed much more slowly than automation of machining. Sales of robots, computer controls and materials handling systems are expected to rise to \$30 bil by 1990, vs \$4 bil in 1982. (Fortune, 21 February 1983.)

Small robot makers will be squeezed out of the market by the entry of big firms like General Motors, IBM and Westinghouse Electric. Westinghouse recently purchased Unimation, the biggest US robot manufacturer, for \$107 mil. Kulicke & Soffa Industries, which spent over \$1 mil on robotics research, will shut down its robot division because of intensified competition. Analysts say in the next 2 years up to 25 robot distributors (half the firms now distributing robots in the US) will either be forced out of the robot business or taken over by bigger companies seeking a piece of the robotics sales bill expected by 1990. (NY Times, 12 January 1983.)

In 1990, robots will eliminate 13,500 - 24,000 jobs in Michigan, but will create 5,000 - 8,000, according to American Society for Training and Development. Social scientists H. Hunt and T. Hunt said the most amazing effect of the double impact of job formation and job displacement is 'skill-twist', or the wiping out of semiskilled and unskilled jobs while demand increases for employees with a significant technical background. The Japanese are expediently introducing robots to the workforce with less impact on unemployment. At one Mazda factory in Hiroshima, Japanese workers told how they were creating a new breed of employees - not blue-collar, not white-collar, but 'rainbow-collar' labourers. These workers had been upgraded from production-line jobs and were training the robots. (NY Times, 31 December 1982.)

Italy: The use of industrial robots in large manufacturing industries has increased, entailing new labour organisation methods and improved working conditions. The introduction of robots represent the most profound organisational change for 50 yr. Examples of large-scale robot users are given. Fiat (Italy), a motor vehicle manufacturer, has seen the number of operatives at work fall from 70% of the total in traditional operations to 10% where robots are installed; meanwhile maintenance operatives have increased from 17% of the total in traditional operations to 71.5% working with robots. Olivetti (Italy), a manufacturer of office equipment, installed its Sigma robots in 1976, and reports successful integration with human workers. Other users of robots, computers and automated equipment include Barilla, a pasta producer that invested ILr40 bil on P&E for labour saving devices in 1981, Indesit, a domestic appliance and TV manufacturer and Ansaldo (all Italy), a producer of electronic components. (Sole 24ore, 14 April 1983.)

West Germany: The installed base of industrial robots rose to 3,500 units, end-1982, vs 1,255 units, end-1980. Despite robots' reputation for taking jobs, the beneficial effect is that the jobs performed are mainly on automotive production lines, monotonous operations or heavy or dangerous work. In 1980, some 60% of installed industrial robots were in the car sector, 12% in the electrical and electronics industry, 10% in the machinery construction sector and 9% in the plastics industry. Robots help to keep West Germany productivity at high enough levels to compete with cheap Japanese and Far-East-produced goods. Thus they are in fact protecting jobs. (Elektronik, 8 March 1983.)

An advanced robot work cell for assembling electrical power connectors to solar cell modules has been developed at California Inst. of Technology's Jet Propulsion Lab as part of a project to develop and demonstrate new technology for the manufacture of low-cost solar arrays. The robot assembly system is comprised of a Unimation PUMA robot, a vision system, and a force/torque wrist sensor. The system solders a tab to the module buss, lays down a glue bead for sealing, and places a connector housing over the tab. Error-handling capability is a particularly important feature of the assembly system. (Robotics T, 5 November 1982.)

Lightweight robots have been invented to direct operations of work-performing robots, which could be too big for programming. US Patent 4,372,721 was awarded to J. Noss and M. Harjar, both of Bordson. Both kinds of robots, made by Nordson, will be used by auto and appliance companies. The nonpowered teaching robot is manipulated by hand in the same place the employee will occupy. (New York Times, 12 February 1983.)

The chemical industry should take advantage of small, inexpensive teaching robots to gain experience in robot use, according to a Royal Soc. of Chemistry meeting. There are currently 400 robots in use in the UK, with use generally justified for batch operations ranging from 200-200,000 parts/yr. Chemical industry applications could include routine sampling and experimental tasks in the lab, materials handling, e.g. lifting and palletising, plant inspection in hazardous areas, product sampling and handling, and plant maintenance, e.g. repairing the inside of pipelines and cleaning out reaction vessels. Advantages could include reduced costs, improved speeds and plant safety. Case studies carried out by Wellcome Foundation, Colne Robotics and AERE Harwell found main problems in the design of the correct gripper and adaptation to existing machinery. As the vision and tactile sensing systems of robots improve, and as the universal end-effectors (grippers) are developed, the uses for robots will expand rapidly. (MfrChemAer, February 1983.)

CAM-I, an international industrial computerization technology institute, will launch a major project to develop software for robots. Since Japan is the world leader in developing industrial robots, Japanese companies and academic institutions that are members of CAM-I (Computer-Aided Manufacturing-International) hope to assume a leadership role in the project by pooling their resources. US and European participants have dominated past CAM-I projects. The new effort envisions development of a robot control system, a human job simulation system, a standardized set of robot-controlling computer languages and a teaching system to make robots memorize and perform jobs. Each of these areas is seen as an essential technological prerequisite for developing the next generation of 'intelligent' robots. (Japan Econ. J., 15 February 1983.)

Grumman Aerospace developed an automated work cell in which a robot trims and drills curved sheet metal aircraft parts. The system reduces cost, increases throughput and is accurate enough to eliminate the need for templates and bushings usually used to guide the tools. Grumman's (Bethpage, NY) work cell is built around an ASEA model IRb-60 robot mounted on a 20' long track, allowing the robot to traverse and operate at 4 separate work stations, 2 located on each side of the track. Each work station can accommodate the holding fixtures for a different sheet aluminum part. While the robot is at work drilling and routing at one work station, the cell's operator is unloading finished parts and fixturing unfinished parts at any of the other 3 work stations, allowing maximum use of the robot to cut metal. Grumman said drilling and routing and average sheet metal part with the robot cell takes 8.5 min., where an average 30 min. are needed in a conventional manual operation. Preliminary cost analyses indicate that the system offers a 30% + cost savings, much which is in eliminating the need for templates. (Am. Mtl. Mkt., 24 January 1983.)

Advancements in robot controls simplify programming and yield accurate, reliable functioning of robots, according to MA Eastwood, GCA Corp., Industrial Systems Group (Naperville, IL.). The most common robot controls are servocontrol, trajectory computation, sensor processing, programme interpretation and external links, which usually use internal microprocessors to implement functions. R&D efforts in robot control are aimed at increasing speed without the loss of smoothness or stability. Other goals include improved absolute accuracy, more processing power, and improvements in sensor technology. In addition, external links will be improved as more robots are used in flexible manufacturing systems and large-scale automated centers. (Tooling P, February 1983.)

Robot vision systems that combine digital computers with TV cameras and advanced software will run the factory of the future. Already machines with electronic eyes are inspecting computer keyboards and sorting steel bars as they emerge from foundries. In addition, there is much activity in the R&D community to apply already developed techniques to new applications or to make existing techniques more efficient and less costly. As a result, a new industry in machine vision now supports 20+ firms that build and market vision systems. A machine vision system usually consists of a TV camera connected to a computer operated by very specialized software that tells the machine how to analyze and interpret images

generated by the TV camera. The algorithms used in industrial vision systems fall into 3 broad classes: binary vision, consisting of B&W images; gray-scale vision that analyzes multiple shades of gray; and light-stripping that analyzes binary images upon which stripes of light have been projected. (High Tech, April 1983.)

Labor-saving robots are finding increasing use in the glass industry. From molding, straightening and transferring applications to palletizing and packaging, the glass industry's use of robots will rise and have an impact on plant operations as management discovers the potential of flexible automation. Up to 250 robots are working worldwide in a range of applications that include producing radar equipment, TV tubes, incandescent bulbs, fluorescent tubes, flat glass jars and glass containers. This is the start of a bright future for robots in the glass industry if management commits itself to this technology. That commitment will grow as more managers become aware of the benefits. Robots will start having more of an impact in handling hot products within the glass industry, the transferring of these items from one conveyor to another, and in packaging glass as a component. Most glass plants engaged in such operations run-around the clock, providing economic justification for using robots, which work consistently, while manual labor requires breaks. (Glass Ind, February 1983.)

Materials-handling robots may account for 15% of robots by 1990, raising plastic composite demand. Celanese Plastic & Specialties supplied the graphite fiber composite in the manipulator arm demonstrated during the 2nd flight of the space shuttle Columbia. The 50-ft arm, with lights, TV cameras and some heavy stainless steel and aluminum elements, weighed 904 lbs, but the 2 graphite fiber sections, accounting for 86% of the arm's length, weighed only 106 lbs.

The conventional material-handling robot used by chemical firms has an articulated arm with joints at the shoulder, elbow and wrist; an end effector or gripper to clasp packages, and a microprocessor that guides the movement of the robot. Platt Saco Lowell, a major textile machinery firm, makes and uses robots, which it claims are more economical than humans for the mundane chore of positioning and replacing spools that collect yarn, although palletizing is the biggest use. Cincinnati Milacron, 1 of the world's largest robot makers, sees many applications for robots in situations where humans could get sick, such as handling toxic and hazardous substances and simple lab mixtures. G. Michael of AD Little reports there is a firm designing robots to mix reagents or test solutions using 1 robot arm with 6-12 peripheral pieces. Article discusses other firms in the industry. (CMR ChemBus, 30 May 1983.)

Tokico (Japan) has developed a robot that will follow stored instructions in operations such as painting. The robot uses a memory unit with less than the usual capacity and can make partial corrections in its procedure. A manipulator operates a wrist and arm that are held in place by support posts above a stationary bed. The wrist and arm are hydraulically operated to direct a paint spray nozzle onto the object to be painted. The robot may also be used for welding, with a torch connected to the manipulator. Tokico was granted US Pat 4,385,358 for the robot. (NY Times, 28 May 1983.)

Lamberton Robotics installed the world's largest fully reprogrammable, multi-axis precision robot at Cameron Iron Works (Livingston, Scotland), where it is already demonstrating productivity gains, materials-handling improvements, and significant material savings. Lamberton's Scobott line handles up to 2,800 lb at furnace temperatures and in dust, fumes, and potentially inflammable vapors. The robots operate at high speeds to accuracies of ± 0.002 ". The Scobott 700 at Cameron is mid-range in Lamberton's new line, and has a maximum work piece velocity of 350ft/min. Its articulated arm has a guaranteed accuracy of ± 0.030 " and it can lift 1,500 lb. The robot enables reduced cycle time, typically 50-60 sec for turbine discs. Material savings result from the robot's accurate positioning capability that can save 25 lb on a 600 lb blank. Specially modified software includes straight line interpolation, acceleration and velocity control, and a high degree of self monitoring. Using a plug in 'teach-box', the robot is taught an operation by being led through its various positions. The Cameron robot's main memory stores 10 programs of up to 500 movements each, with an additional 100 programs available through an auxiliary floppy disc or tape system. (Robot Age, April 1983.)

A sludge robot that cleans sediment from the bottom of a tank and gets rid of it outside has been developed by T. Svensson. US patent 4,381,237 was awarded for the invention. The robot has 2 connected arms that rotate to sweep the bottom area of the tank, take in the sludge and particles by suction and send them out through a vertical arm. A microcomputer program for the tank may be used to control the robot. (NY Times, 7 May 1983.)

Volvo (Sweden) is developing a reinforced rubber welding cable to improve robot welders' profitability. Under test conditions, the cable has withstood 1 mil cycles, vs 6,000-7,000 for a conventional cable. At present, the entire cable is scrapped if the rubber covering splits and cooling water leaks out, although the wire conductors inside the cable are undamaged. The new reinforced cable will substantially reduce this type of wastefulness. The material and shape of the core which separates the wire conductors from each other have also been improved. A new cable will be manufactured in Italy by a Swiss company as from spring-1983. A patent has been applied for. (SIP News, 28 January 1983.)

Daikin Kogyo (Osaka) developed a welding robot that can work over wavy, meandering and zigzagging surfaces. The robot is micro-computerized and runs on rails. It can weld long plates of steel and other sheeting up to 22 yds. Conventional welding robots lose their processing precision as they move over longer and wider areas, but the new robot only needs instructions on where to start, what to do and the shape of the cross sections of the welding parts. It moves horizontally, and is guided by small rails running along the cross sections. The proper distance between the welding points and the torch is monitored and adjusted by an arc sensor, which is linked with a microcomputer. (Asian WSJ, 4 April 1983.)

General Electric has a new sensor system bringing sight and intelligence to welding robots. The 'weldvision' system allows a welding robot to steer itself along irregularly shaped joints, making adjustments as it moves and will increase welding robot output 15X. The system is 2X as fast as manual welding. Deliveries will begin by the end of 1983. (NY Times, 20 April 1983.)

Robotic welding is a fast-growing metalworking technology, but not suitable for all circumstances. In just a few years, the technology has emerged from large automobile assembly plants to be incorporated as a profitable alternative to manual and semiautomatic welding by small firms such as those serving the automobile industry. In the small firm environment, robotic welding expenditures may be justified easier and faster than in large firms because of less red tape and more management involvement in details. According to J. Gage, Advanced Robotics (Hebron, OH), robotic welding represents one of the major advances in welding in 20-30 yrs. This is corroborated by Predicasts (Cleveland, OH), which pegs sales of robotic spot-welding systems at \$2.1 mil in 1972 to reach \$100 mil in 1985 and \$680 mil in 1995, up 42%/yr. The combined use of robot and computer technology gives robotic spot welding much more flexibility than welding transfer lines, especially for small batch adaptability and frequent model changeovers, according to H. Ruf, VP of Expert Automation (Sterling Hts, MI).

However, before investing in a robotic welding system, firms need to consider several criteria: the quantity of parts in batch runs; the degree of quality required; the fixturing of parts in an accurate, repeatable fashion; the size and shape of parts to be produced; job complexity; and arc times. (Tooling P, March 1983.)

SOCIO-ECONOMIC IMPLICATIONS

Excerpts from the new book "Algeny"*, by Jeremy Rifkin, which explains how computers and genetic engineering are teaming up to reshape our entire economic structure.

Computer begins new era

...The entire industrial era ran its course without the aid of the computer. This new organizing mechanism didn't come "on-line" until the mid-1960s. It didn't begin to exert a commanding presence until the early 1980s. The computer only caught the tail end of the industrial era. While it will no doubt be used in a myriad of ways to stretch out the remaining years of the industrial epoch, its real import has yet to be gleaned by the future forecasters. The computer is the organizing mechanism for the age of biotechnology, just as the industrial machine was the organizing mechanism for the industrial revolution. Whereas the machine transformed non-renewable resources into economic utilities, the computer will transform biological material into economic products and processes. The computer is also the language of the biotechnical age. Every great economic period brings with it a unique form of communication. Hunter/gatherer societies relied on sign and oral language, while every advanced agricultural society had some form of written language. The printing press was used during the early stages of the industrial revolution. No self-respecting anthropologist, however, would refer to the Paleolithic period as an oral economy, or the Neolithic period as a written economy, or the Industrial Age as a print economy. Yet today's futurists believe that what lies ahead is the computerized information economy. They fail to understand that the computer and information sciences do not in and of themselves comprise the new economy. Rather, they comprise the organizing language for the new economy. They are the means of communication that humankind will use to reorder living material in the biotechnical age.

In 1981, the first computerized gene machine made its debut. One need only type out the genetic code for a particular gene on the computer's keyboard and within a matter of a few hours "the machine delivers a quantity of synthetic gene fragments that can be spliced together and put into the DNA of living organisms". With the gene machine it is possible to begin transforming living material into new designs and products in large enough volumes and with sufficient speed to provide a cost-effective starting point for the biotechnical economy. This, however, is only the beginning stage of the coming economic revolution. Eventually scientists hope to mesh living material and the computer into a single mode of production. Already, corporate funds are being channeled into research designed to replace the microchip with the biochip and the microcomputer with the biocomputer. According to James McAlear, president of EMV, one of the firms pioneering in this research: "Our aim is to build a computer that can design and assemble itself by using the same mechanism common to all living things. This mechanism is the coding of genetic information in the self-replicating DNA double helix and the translation of this chemical code into the structure of protein."

Within the coming decade, the computer industry and the life sciences are expected to join together in a new field - molecular electronics. Companies like Japan's Mitsui Corp. are already planning for the day by acquiring "a large stake in both biotechnology and microelectronics". The grand objective is to turn living material into biocomputers and to use these biocomputers to further engineer living materials. In the future, biocomputers will be engineered directly into living systems, just as microcomputers are engineered into mechanical systems today. They will monitor activity, adjust performance, speed up and slow down metabolic activity, transform living material into products, and perform a host of other supervisory functions. Scientists even envision the day when computers made of living material will automatically reproduce themselves, finally blurring the last remaining distinction between living and mechanical processes....

... Our children are beginning to conceptualize the world in a fashion so fundamentally different from anything we can readily identify; with that the empathetic association that traditionally passes down through the generations, uniting past with future, seems at times to be irretrievably severed - as if to suggest the termination of one great lifeline in history and the abrupt beginning of another. Our children are the first sojourners of the second great economic epoch. While they still carry with them most of the conceptual trappings of the age of fire, they are beginning to experience the world from a profoundly altered frame of reference.

* The term "algeny", coined by Dr. Joshua Lederberg of Rockefeller University, means to change the essence of a living thing by transforming it from one state to another: more specifically, it is the upgrading of existing organisms and the design of wholly new ones with the intent of "perfecting" their performance. Algeny is humanity's attempt to give metaphysical meaning to its emerging technological relationship with nature.

To begin with, their language is the language of the computer. Their world of communications is made up of computer programs, electronic games, word processors, video disks. The average American child now spends approximately 28 hours per week with electronic learning tools, compared to 25 hours per week with print learning materials. The electronic image and the computer printout are increasingly taking the place of the spoken and written word. A New York Times article reports mathematician Seymour Papert of MIT saying that "the effect of the computer on learning and thinking is comparable to that of the invention of writing".

Alan Newall of Carnegie-Mellon University, one of the experts in the new field of artificial intelligence and the computer sciences, argues that the true import of the computer is that it opens students' minds to a "whole new language for describing behavior". This new language is drastically altering our children's perception of the world. Many educators now believe that our young people are beginning to conceptualize the world in the same terms that animate the operations of a computer system.... (Quoted from a reprint in Datamation, May 1983.)

Automation curtails strike

The recent strike of US telephone workers is a blatant example of how automation can outsmart workers: although 675,000 telephone workers went on strike, the fully automated telephone lines all across the country were still functioning. Services normally still carried out by manual labour such as repairs, were temporarily being handled by the 200,000 higher and middle level employees who were not participating in the strike.

Computer arrogance

The gap between people who run computers and those who don't is growing. The NY Academy of Sciences conference on Computer Culture allowed both sides to vent frustrations and examine the problem. Ordinary people could be at the mercy of technocrats, since many people remain ignorant of computers due to the 'arrogance' of computer scientists, according to psychologist D. Norman of the University of California (San Diego). Still, basic concepts of computer use will become as essential as knowing how to drive. Computers will have to be designed for easier use, since even manuals for 'easy-to-use' computers are currently full of technical jargon that is unintelligible to the layman. The tendency of American management to reduce work to simple tasks, to give each worker an unvarying task and to remove all quality control from the plant to a central office must come to an end in the computer age. Allowing production workers to make decisions is the only way to prevent the illusion that human knowledge is no longer needed in manufacturing. Computers will eventually be able to reason by processing symbolic inferences. Expert systems are already being developed to diagnose patients, play chess and analyze organic chemical structures. (New Scientist, 14 April 1983.)

Microprocessors against unemployment

The tenth conference of European christian-democratic trade unions held in July in South Tyrol, discussed "work for all - employment for all". The main lecture was held by Professor G. Bruckmann, Technical University of Vienna, dealing with technological development at the work place. As regarded employment in Austria, Professor Bruckmann pointed out that an additional 300,000 jobs could be created if microelectronics were fully embraced, on the other hand just as many jobs would be lost if Austria missed the opportunity. As the value of the work increased, one could better afford shorter working hours. If one wanted to keep jobs in branches that had become obsolete and keep them at any cost, one really jeopardized other jobs. (Die Presse, 8 July 1983.)

Pressure mounts for computer comfort

American computer companies are under pressure from European customers to come up with screens and keyboards that are designed with their human operators in mind. Burroughs recently had to spend two years redesigning a range of terminals to European standards in order to win back lost orders in Germany where trade unions insist on well-designed equipment. The exercise involved setting up a human factors (ergonomics) centre in New Jersey and hiring a top ergonomist from Zurich who had already been retained by several large companies to advise them on the design of the computers they were going to buy. "We thought we might as well have him on our side as well," said a company executive. Professor Etienne Grandjean of the Swiss Federal Institute of Technology was brought in to sort out Burroughs's keyboard and screen. "Companies do not have much knowledge of ergonomics. Some of their advertising which talks about ergonomics is misleading," he added.

European manufacturers such as Datsaab, Kienzle, Philips and Olivetti have been ahead of their American counterparts, with the exception of IBM, in producing machines for people. Union demands for safe equipment and the establishment of ergonomics as a bona fide science have led to government directives in Germany and Sweden which lay down standards for visual display units among other pieces of office equipment. The British Health and Safety Executive last week published its recommendations on the introduction and use of VDUs. The report was delayed by internal wrangling over the emphasis of the booklet. In the end it concentrates more on the use of the machines, than on their construction. In Germany the directives are given extra teeth because the body which has laid down the ground rules, the Berufsgenossenschaft, is also responsible for handling insurance claims for industrial injuries. If employers buy badly designed equipment then they are in danger of having to pay up if it injures someone.... (New Scientist, 23 June 1983.)

INFORMATION TECHNOLOGY

Euro-MPs may have own terminals.

Every Euro-MP should have a computer terminal in his own home to link into Euro databases. That resolution was proposed recently at the European parliament in Strasbourg by Silvio Leonardi, an Italian Communist Euro-MP. The resolution was too vague to be effective, commented an official in Luxembourg last week, but if passed it would establish the principle for the future. A formal vote is not required to approve it - it simply needs a certain number of Euro-MP's signatures in six weeks to get it on the record.

Leonardi's proposal follows on from one approved by the European parliament in July last year. That one was also proposed by an Italian, the Socialist Euro-MP, Mario Zagari, and it established that the European parliamentary workload, which is spread across three countries, should be speeded up as much as possible using information technology. (Computer Weekly, 21 July 1983.)

INMARSAT approvals

The International Maritime Satellite organisation (INMARSAT) has approved applications for two coast earth stations in Saudi Arabia and for a land-mobile station in Bahrain. Saudi Arabia, not yet a member of INMARSAT, intends to construct two coast earth stations which would give it access to the INMARSAT satellite system, which provides the capacity for telephone, telex, facsimile and data services to the shipping and offshore industries. (Electronics Weekly.)

South America sees growth in satellite use

The Brazilian government's telecoms company Embratel has signed a contract with the Canadian firm Aerospace Ltd. This is to provide two communications satellites and the associated ground control systems.

Honduratel, the national telephone company of Honduras, has awarded a \$1.6m contract to Harris Satellite Communications Division for the installation of the country's first communications by satellite system. The order calls for a terrestrial station to International Standard B to be constructed in the vicinity of Tegucigalpa.

An important geological survey project using three US satellites is about to be concluded by the Bolivian Geological Service (GEOBOL). The data obtained is being stored on discs and tapes. It will be used to prepare maps of the country's geomorphology, land use, geology and water resources. The main initial use of the data will be for mining and agriculture.

The Mexican communications and transport secretariat is about to establish inter-connections with COMSAT, the US Communications Satellite Corporation and thus with INMARSAT, the international organisation for marine communications by satellite to which some 37 countries already belong. This will permit direct telex interchanges from Mexico with ships in the Pacific and the Atlantic. Through a private telephone line with COMSAT and an agreement with Teléfonos de México an automatic telephone service can now be provided with ships and oil rigs. (Electronics Weekly.)

Luxembourg eyes managers for its information course

The smallest member of the EEC has seized the initiative to ensure that European managers get training in dealing with the information from large computerised databases. Last week the Luxembourg government announced that it is looking for 50-60 bright candidates, preferably from the DP industry, to take part in the first diploma course in the newly founded European Institute for Information Management in the Grand Duchy. "The problems of information handling in multi-million dollar installations are not technical problems but management problems", said Derek Barlow, who is Secretary General of the European Information Providers Association, and a director of the international institute. That is why he is approaching information service and computer companies to send good middle managers who are being groomed for high positions on the course, which concentrates on effective management of database and information systems.

The course comprises four 150-hour long modules which can be taken separately. They examine the information environment in the context of national policies, the managing techniques applied in information systems, the marketing and economics of information systems, and have case studies to illustrate how information is handled within organisations. The cost is \$2,000, including computer time, for the full 600 hours of teaching and practical training. Teaching will be in French and English. There will be about 20-30 lecturers from both universities and industry. The European Commission has a representative on the international board of directors of the institute, but is not helping to fund its administration. More information on 01-586 7693. (Computer Weekly, 7 July 1983.)

Using computers to meet foreign competition

A national network of advanced computers to help the U.S. meet foreign competition in technological development and scientific research has been proposed by John J. Roberts, associate director for energy and environmental technology at Argonne National Laboratory (Argonne, Ill.). The network would link computer scientists at major research laboratories, universities and companies. Besides meeting the computer needs of researchers, Robert says, it could stimulate the development of computers and programs tailored to scientists' specific needs, and could lead to important collaborations. Fields of research that could benefit, he says, include basic materials science, fusion energy, nuclear reactor safety research, high-energy physics, medical diagnostics, and studies of combustion reactions. (Chemical Week, 6 July 1983.)

RECENT PUBLICATIONS

Relevant UNIDO documents

- ID/WG.401/6 Some considerations about practical approach to the development of technical infrastructure for microelectronics, by G.F. de la Garza;
- ID/WG.401/7 Report on the workshop on institutional and structural responses for developing countries to technological advances held at Dubrovnik, 31 May to 4 June 1983;
- UNIDO/IS.400 Prospects of technology transfer registries computerization, prepared by the Secretariat.

World Bank report says microcomputers revolutionize information-processing in the third world

The microcomputer is fast revolutionizing information-processing techniques in third world nations, according to the World Bank. The Bank's world development report for 1983, says the recent advances in microcomputers and associated software have greatly reduced the cost of processing large quantities of data. The new technology has been particularly useful in the coordination of planning efforts, budget-system reform and project monitoring. Being relatively cheap, portable, resilient and easy to operate, microcomputers are suitable for work in rural areas and for middle and junior managers who have no special programming skills, the report says. But it warns that the accounting and other systems to be computerised must be adapted for handling by computer to take full advantage of the benefits. An appropriate set of indicators must be designed for a project to be monitored effectively by computer. This, the Bank says, requires a substantial investment of skills and time.

The Bank has identified two countries undergoing a management information revolution, Kenya and Nigeria. In Nigeria, for example, microcomputers are now handling data from farm management surveys on nine agricultural projects, three of which cover entire states. First introduced in August 1981, the computer was in operation two months later. By June 1982, 17 machines were in use, with another 11 on order. The Bank says the field staff in Nigeria needed only two weeks' training in operation and preventive maintenance. The Nigerians now enter data directly onto computer files, thereby avoided the need to code and cardpunch numerous survey forms for later analysis. As a result, managers now obtain reports within a month of survey completion, and they can also handle large quantities of data bunched at peak seasons.

The report also points out that Kenya's ministry of agriculture introduced microcomputers in 1981 to improve its annual budgeting process. The report points out that as a result of its use of microcomputers, the Kenyan ministry of agriculture has effectively regained control of its budget from the finance ministry. (IFDA, Special United Nations Service, 27 July 1983.)

Micros in Early Education, by Pamela Fiddy & David Wharry. Longman, £2.25.

Just what I've been waiting for - a guide to using micros in the classroom. As a teacher with no knowledge of computers, and faced with the prospect of using one in my classroom in the near future, I found this book informative and, more importantly, extremely encouraging.

The authors set out to tell the timorous beginner how to organise the classroom and children, about the different purposes a micro can serve, and how to make good educational use of electronic toys. This is achieved using admirably plain language. The jargon so beloved of those in the know is explained in a clear and precise manner so that even I would feel confident to use terms such as hands-on experience and bit pad.

Plenty of ideas for the development of systems are suggested, and the appendices form a comprehensive list of further sources of information. The photographs are useful in assisting the novice to identify pieces of equipment and in showing what selected programs look like on the VDU. I was not so impressed with the cartoon-style illustrations however.

In the first chapter we see the enthusiastic wild-eyed woman teacher using a micro with a class of children, but by the time we reach chapter three who is shown writing the programs and doing the technical things? A man of course. Microcomputers in Early Education is a practical and basic guide for the complete beginner. After reading it, I actually began to look forward to the delivery of our micro, rather than dreading it. (Reviewed by Christine Penfold in Computer Weekly, 14 July 1983.)

The Wealth of Information, by Tom Stonier, Thames/Methuen (1983), £4.95.

Just as J.K. Galbraith's The Affluent Society defined the agenda for economic debate in the 1960s, and E.F. Schumacher's Small is Beautiful set the tone of the 1970s, so Tom Stonier's thought-provoking little book may well turn out to be a seminal work of the 1980s. In short, it is a minor classic though Stonier is not in the same league as his heroes, Adam Smith and John Maynard Keynes.

His main thesis is simple: information adds value. The accumulation of information is as important today as the accumulation of capital, and becoming more so. Knowledge can convert deserts into fertile cropland. Even machinery is more than just muscle-power in metal. Each machine embodies within itself an intellectual history of invention and discovery. And of course one machine stands pre-eminent in the information economy - the computer. As the necessity for physical labour continues to decline, we are fast becoming a nation of programmers and information technologists.

More interesting is Stonier's forecast of a second silicon revolution - based on the photo-voltaic cell (close cousin of the transistor) which promises cheap, clean solar energy for the Third World. Most of the world's poorer countries are blessed with abundant sunlight, and their economies would be transformed by such an energy source. From megabytes to megawatts! Silicon, one of the commonest elements on earth, is more precious than gold; and the alchemical ingredients that turns sand into riches is knowledge. Once we recognise the value of knowledge, we will have to re-write economics, for as Stonier says: "Information is a resource which can be truly shared." When I tell you something, I do not thereby diminish my own store of information. Indeed, most find that the attempt to impart information often

enriches the teller's knowledge. Thus while competition is the norm of land, material goods etc, co-operation is, or should be, the normal mode of information exchange. As we move into an age where information technology supplants manufacturing as the dominant source of wealth there are grounds for hope that this fact may rescue mankind from the excesses of competitiveness.

We have just witnessed an election campaign full of calls for Victorian values and other outdated remedies. Our leading politicians display a poverty of ignorance about the wealth of information. The publishers of this book should send a free copy to every member of the new Cabinet - and lock them up until they have read it. (Reviewed by Richard Forsyth in Computer Weekly, 14 July 1983.)

Information Society: for Richer, for Poorer, edited by N. Björn-Anderson et al, Elsevier, pp 320, \$51.75.

The book is a product of a conference organised by the EEC Commission's FAST (which stands for "Forecasting and Assessment in the field of Science and Technology") programme which took place at Selsdon in January last year. What the conference was supposed to do was to pinpoint the potential winners and losers of the microelectronics revolution and then suggest ways of turning losers into winners as well - a tall order, given that the 120 participants, including industrialists, politicians and unionists as well as the more usual academics and general pundits, could be guaranteed not to come up with anything approaching consensus.

The contributors are not quite as diverse as the above description might imply. The industrialists have only one champion, from IBM UK. The unionists turn out to be mainly union research workers. I could identify just two women out of 32 writers. Britain is over-represented compared with other EEC countries, especially France.

So, have the contributors taken up the Selsdon challenge? Sadly, most of them wander from the point. Throughout the main sections of the book - on the nature of the information society, government policies, exposed groups, options for society, work organisation, union response and the adoption of new technology - there is a reluctance to name names. There are some honourable exceptions. Helga Novotny focuses on four groups - the poor, computer illiterates, women and general misfits (her order, not mine) - who are likely to miss out on the revolution. Juergen Reese writes of how the technologising of the social services could easily lead to more, not less, red tape for us. Mike Cooley and Howard Rosenbrock reiterate their familiar but important points about designing technology around people, not machines, so that the producers and users of information technology do not themselves become losers. But others exhaust their contributions in merely giving lists of possible applications of microelectronics or, worse, in detailing yet again (and for a specialist audience!) the growing power and storage capacity and the declining price of integrated circuits.

Readers are of course free to pick and choose the chapters they find most worthwhile, and there is much useful information contained in many of the contributions. But everyone should turn to the interesting final section where the editors try to integrate the reports of the conference working groups and to return to the central themes of who wins, who loses and how any necessary changes can best be planned. In their "Selsdon plan" they come out in favour of a "European" route to the information society that differs from both the "free market forces" American approach and the "subservience to the organisation" path of Japan. This "Third Way" would be both democratic (allowing participation and co-determination at all levels) and caring (taking into account different national traditions, political and industrial situations, regional, local and social needs). Government would take both a regulatory and a supportive role, keeping a careful watch for people and groups who might be falling away from general social progress.

How far such an approach could succeed is, as the editors admit, open to question. In his forward Viscount Davignon, vice-president of the European Commission, points graphically to the areas not covered by the conference: the EEC countries account for scarcely more than 1 per cent of the world's land mass and a declining 6 per cent of the world's population. Though Europe's economic power is far in excess of these figures, the implied point - that many of the real problems are global - is well-taken. Even solving the problems the book does deal with is not going to be easy. For instance, the working group on education states emphatically that, "all education in a democratic society (has) to have as its first objective the training of students for an active role in which the individual takes responsibility for his/her own destiny". The editors add, with sweet understatement, "This would be a great challenge to many introductory courses in administrative data processing." (Reviewed by Graham Thomas in New Scientist, 23 June 1983.)

Safety code call for chip controlled processes

More accidents will occur with the proliferation of increasingly complex chip-controlled industrial processes unless a code of safety practice is agreed, says a report published last week, "Manufacturing and Service Industries. Health Safety 1981." Her Majesty's Stationery Office, 1983. £6.50.

It points out that although microprocessor-controlled systems, for example in robotics, offer considerable benefits in terms of productivity and quality, there are inherent safety problems. Unconventional precautions have to be taken as electronic failure modes are complex and not always predictable, the devices are susceptible to electrical interference, and latent software errors may cause dangerous situations.

These problems are being examined by the Health and Safety Executive. It is drawing up a code of practice which will provide advice on safety, environmental and operating considerations. The safety aspect will emphasise programming considerations, back-up systems and emergency shutdown systems, and reliable software. The environmental considerations will deal with problems caused by electrical interference and fire protection, and guidelines will be laid for operating and maintenance. (Reviewed in Computer Weekly, 28 April 1983.)

Technological trends and challenges in electronics

Dominance of the Industrialized World and Responses in the Third World, edited by Staffan Jacobsson and Jon Sigurdson and published by the Research Policy Institute, University of Lund, Sweden (1983). (SEK 95).

This book brings together a number of highly detailed case studies that analyse the likely effects of the new electronics technologies. Some chapters deal with the impact of electronics on the engineering, garment and computer industries. Other examine the potential of CAD and the possibilities for machine tool producers in the developing countries to keep up with the rapid technical change. A survey is also provided of the electronics industries in China and India. A concluding chapter discusses the lessons that can be drawn from such analyses for industrial strategies in the Third World.

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