CONTINUUM
306 SPADINA ROAD, TORONTO (416) 960-3289

THE COMCON CONFERENCE

Meridien Hotel, San Francisco
February 28 - March 1, 1984

A Trip Report
for the
Ministry of State
Science and Technology

by

A. Stein and G. Heil
of
Continuum Inc.

compcon 84 spring committee

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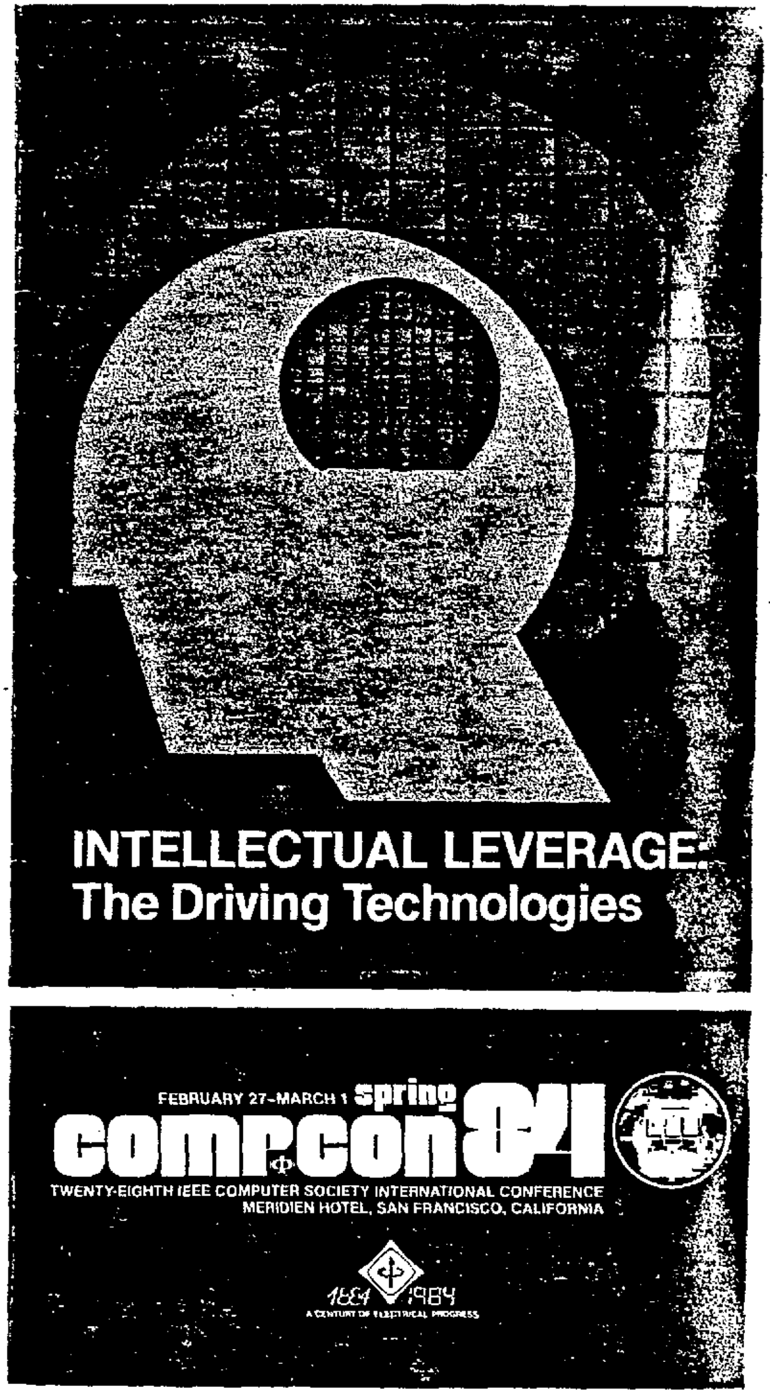
conference at a glance



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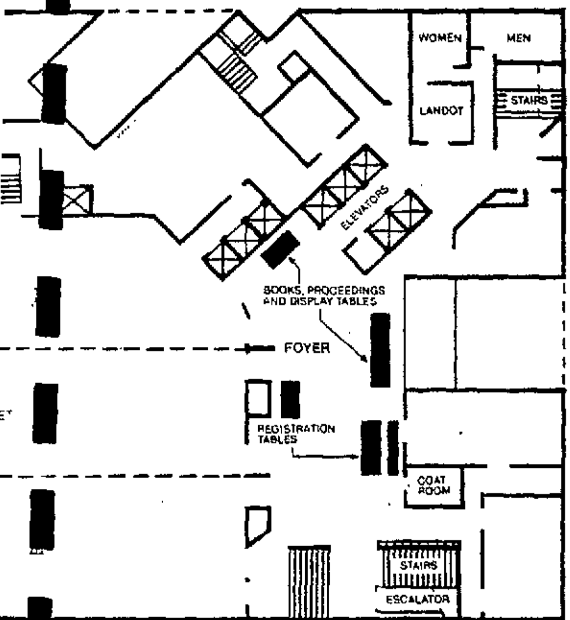

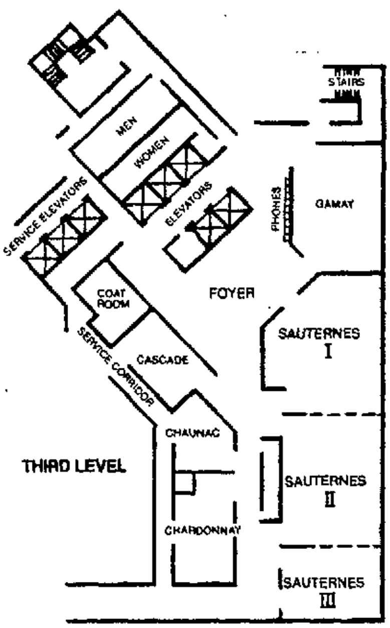

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pre-conference tutorials

MONDAY, FEBRUARY 27, 1984
9:00–5:00 PM

TUTORIAL 1
Expert Systems with Applications in Computer-Aided Design and Computer-Aided Testing
Tulin E. Mangir

TUTORIAL 2
Expert Systems (Knowledge Engineering)
Kamran Parsaye and Henry Sowizral

TUTORIAL 3
Local Area Networks
Ira W. Cotton

ontinued from previous page)

final program

Thursday, March 1, 1984

SUPER COMPUTERS (Cabernet II)

1:30–3:00pm

SESSION 29: INNOVATIVE COMPUTER SYSTEM ARCHITECTURES FOR AI
Chairperson: W. Trattnig, Stanford University
Rediflow Multiprocessing — R. M. Keller, F. C. H. Lin, J. Tanaka: University of Utah
Design Issues in Parallel Architectures for Artificial Intelligence — C. Hewitt, H. Lieberman: M.I.T.
Some Thoughts about Supercomputer Organization — J. D. Ullman: Stanford University

SPECIAL SESSION: TUTORIAL ON IEEE E-MAIL SERVICE (IN SAUTERNES III) Details on last overleaf.

3:30–5:00pm

SESSION 33: NEW GENERATION COMPUTER ARCHITECTURES
Chairperson: G. E. Lindamood, Office of Naval Research
An Architecture of a Data Flow Machine and its Evaluation — T. Shimada, K. Hiraki, K. Nishida: Electrotechnical Laboratory
A Second Generation 32-bit CMOS Microprocessor — H. A. Hoeschen, J. Agraz-Guerena, A. K. Goksel, V. K. L. Huang, H. S. Jacobs, P. M. Lu, H. F. S. Law, W. F. Miller, P. A. Swartz: Bell Laboratories
A Memory Unit Management for A Second Generation Microprocessor — A. K. Goksel, J. Agraz-Guerena, H. S. Jacobs, J. J. Molinelli, P. A. Swartz, Y. K. Wo, W. W. Troutman: Bell Laboratories

SOFTWARE SYSTEMS (Cabernet I)

SESSION 30: MODULA-2 — A REPLACEMENT FOR PASCAL?
Chairperson: C. Jacobi, Xerox Palo Alto Research Center
Program Calls in Modula-2: A Simple Overlay Concept — T. Gorrengourt, W. Steiger: Logitech
Modula-2: Good News and Bad News — M. Powell: DEC Western Research Laboratories
Debugging Modula-2 Programs on the Lilith Computer — C. Jacobi: Xerox PARC

SESSION 34: UNIX: RIDING THE CREST
Chairperson: D. Ferrari, Computer Science Division
UNIX in a Network of Personal Workstations — W. N. Joy: SUN Microsystems
UNIX Portability — J. Schriebman: Unisoft
The Evolution of Berkeley UNIX — D. Ferrari: Computer Science Division

WORKSTATIONS & VLSI (Cabernet III)

SESSION 31: STRUCTURED VLSI DESIGN
Chairperson: D. Soderman, LSI Logic
Transforming an Ada Program Unit to Silicon and Testing It in an Ada Environment — T. M. Carter, A. Davis, A. B. Hayes, G. Lindstrom, D. Klass, M. P. Maloney, B. E. Nelson, E. I. Organick, K. F. Smith: University of Utah
HCMOS Gate Array Design Approach — D. Soderman, E. Wan: LSI Logic
The Future is Custom — R. C. Joy: AMI

SESSION 35: MAGNETIC VS. OPTICAL STORAGE — A NEW BALLGAME?
Chairperson: A. Hoagland, University of California at San Diego
A Comparison of Optical and Magnetic Storage Devices — J. Rodriguez: STC
Magnetic and Optical Data Storage: A Comparison of the Technological Limits — A. Bell, V. Marrello: IBM Corp.

APPLICATIONS ... OTP... (Sauternes I/II)

SESSION 32: AUTHORSHIP TOOLS
Chairperson: J. H. Walker, Symbolics Inc.
First Aid to Authors: The IBM EPISTLE Text-Critiquing System — K. Jensen, G. E. Heidorn: IBM Thomas J. Watson Research Center
Authorship Provisions in AUGMENT — D. Engelbart: Tymshare, Inc.
Text Development and Management in UNIX-Based Projects — R. Glushko: Bell Laboratories
Symbolics Sage: A Documentation Support System — J. H. Walker: Symbolics Cambridge Research Center

SESSION 36: UPDATE ON STARS (PANEL SESSION)
Chairperson: S. T. Redwine, MITRE
Software Engineering Environment (SEE) — H. G. Stuebing: NADC
Air Force STARS Efforts — R. J. Almassy: STARS Joint Program Office
Army STARS Efforts — R. Stanley: STARS Joint Program Office

SPECIAL SESSION: TUTORIAL O... SERVICE (IN SAUTERNES III — W... 1:30PM, REPEATED THURSDAY...
Chairpersons: W. Fife, George...
Features of Compmail+, The Cor...
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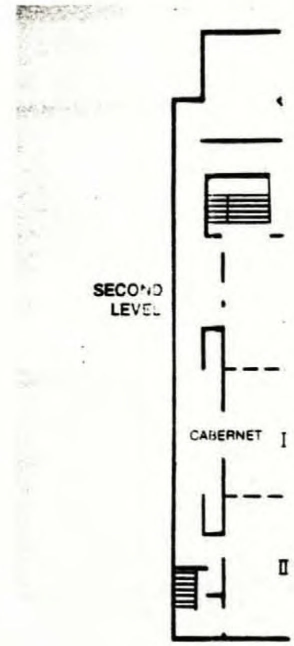

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Tuesday, February 28, 1984

	1:30–3:00pm	3:30–5:00pm
SUPER COMPUTERS (Cabernet II)	**SESSION 1: NUMERICAL SUPERCOMPUTERS** Chairperson: K. Stevens, NASA Ames Research **Great Gigaflops and Giddy Guarantees** — N. R. Lincoln: Control Data Corporation **Computational Aerodynamics and Supercomputers** — W. F. Ballhaus, Jr.: NASA Ames Research Center **Data Flow Ideas for Supercomputers** — J. B. Dennis: MIT Laboratory for Computer Science	**SESSION 5: SUPER SCIENTIFIC CON** Chairperson: G. Michael, Lawrence Live National Lab **Concurrent Processing for Scientific C** G. Fox: California Institute of Techno **Machine-Independent Techniques for Super-Computing** —C. Arnold: ETA S
SOFTWARE SYSTEMS (Cabernet I)	**SESSION 2: FROM LOGO TO LOGIC PROGRAMMING** Chairperson: J. R. Allen, The LISP Company (T(LC)) **Is LOGO the Fifth Generation BASIC?** — J. R. Allen: The LISP Company (T(LC)) **Functional Programming: A Prospectus** — J. desRiveries: Xerox PARC **Logic Programming Is NOT Circuit Design** — R. E. Davis: University of Santa Clara	**SESSION 6: EVALUATING PRODUCT SOF** Chairperson: R. Kleir, MDS-Qantel **VisiCorp's Software Evaluation** — R. Fisc K. Lynn: VisiCorp **Practical Tools for Software Test Certificat** D. Casey, R. Erickson: Software Rese Associates **People, Not Programs** — R. Dalton: Whol Software Catalog and Review
WORKSTATIONS & VLSI (Cabernet III)	**SESSION 3: OFFICE AUTOMATION** Chairperson: T. A. Laliotis, Hewlett-Packard Company **The Trusted Office of the Future** — P. G. vonGlahn, D. J. Farber, S. T. Walker: University of Delaware **A 1990 Scenario, Personal Augmentation — The Human/Machine Interface**—R. G. Tobey: The Diebold Group **Document Scanning in Office Automation** — A. L. Spitz, T. H. Laliotis: Hewlett Packard Company/Cygnet Systems Inc.	**SESSION 7: END USER COMPUTING I OFFICE** Chairperson: D. Liddle, Metaphor **Exchanging Data Between Personal Co Programs** —D. C. Smith: Visicorp **Generic Coding In an Interactive Editor** – C. Simonyi: Microsoft **A New Wave User Interface for the Offic Airplane** —E. Harslem: Apple Comp
APPLICATIONS & POTPOURRI (Sauternes I/II)	**SESSION 4: VIDEODISCS AND MICROCOMPUTERS** Chairperson: D. Carlson, Video Initiative **Interactive Video Disc Technology in Point-of-Purchase Displays** —Debra Kuhns: Apple Computer **Some Elements of Interactive Video Design** — M. Slade: Designware	**SESSION 8: LASER PRINTERS** Chairperson: B. K. Reid, Stanford Univer **The Design of a Device-Independent Print Format** —C. Geschke, D. Brotz, J. Wa Adobe Systems, Inc. **To Be Announced** — C. A. Bigelow: Sta University **To Be Announced** — L. Trabb-Pardo, C. R IMAGEN Corporation

program

Wednesday, February 29, 1984

8:30–10:00am	10:30–noon	1:30–3:(
SESSION 9: MOLECULAR COMPUTING Chairperson: F. L. Carter, Naval Research Laboratory **Prospects for Computation at the Molecular Size Level** — F. L. Carter: Naval Research Laboratory **Switching and Charge Storage in Transition Metal Complexes — Smart Molecules?** M. K. DeArmond, K. W. Hank: North Carolina State University **Potential Electronic Applications of Biological Materials** — K. M. Ulmer: Genex Corporation	**SESSION 13: FAST IEEE FLOATING-POINT ARITHMETIC** Chairperson: W. Kahan, University of California **Pipelined IEEE Floating-Point Processors** — F. Ware: Weitek **The MC68881: The IEEE Floating-Point Standard Reduced to One VLSI Chip** — V. Shahan: Motorola **Algorithms for IEEE Floating-Point Arithmetic** — J. Chang: Sky Computers	**SESSION 17: SUPER MICR** Chairperson: D. Patterson Division **Z80,000 32-Bit Microproces** Zilog, Inc. **NS32032 Design Decisions** National Semiconduct **VLSI VAX Microcomputer** – Digital Equipment Corp **MicroVAX 32 — A VAX Cor** — B. Supnik, I. Evans: [**SPECIAL SESSION: TUTC SERVICE (IN SAUTERNES overload**
SESSION 10: EXPERT SYSTEMS I Chairperson: S. Mittal, XEROX PARC **Knowledge Programming in Loops** — M. Stefik, D. G. Bobrow, S. Mittal: Xerox PARC **A Framework for Circuit Design** — C. Tong: Stanford University	**SESSION 14: EXPERT SYSTEMS II** Chairperson: K. Parsaye, Computer Science Research International **Distributed Heuristic Agents** — H. Sowizral: Rand Corporation **CARE: A Real World Medical Knowledge Base** — C. J. McDonald, A. Blevins, T. Glazener, L. Lemmon, D. Martin, M. Valenza: Indiana University Medical Center **MYCIN in a Logic Programming Environment** — S. Narain: Rand Corporation	**SESSION 18: LOCAL AREA AND THEIR IN** Chairperson: M. Graube, T **Local Area Network Standar** **Implementing an Ethernet L** E. Efron, J. P. DeVita: A **IEEE Token Bus LAN Implen** — R. Douglas: Concord **Implementation of Standard for Development and Ver** Excelan **Data Communications Stan Manufacturing** — K. G. F Workman: General Mot
SESSION 11: NETWORKED WORKSTATIONS Chairperson: M. Martin, SUN Microsystems Inc. **The Evolution of the Apollo Domain** — D. Nelson, P. J. Leach: Apollo Computer **Standards and Performance Issues in the Workstation Market** — V. Pratt: Sun Microsystems, Inc. **A Distributed Workstation Architecture: The Convergent Cluster** — B. Kelman: Convergent Technologies **Workstation Market Issues** — M. Martin: SUN Microsystems, Inc.	**SESSION 15: HIGH PERFORMANCE GRAPHICS TERMINALS AND WORKSTATIONS** Chairperson: R. Chew, Tektronix **The Architectural Evolution of a High Performance Graphics Terminal** — D. J. Doornink, J. C. Dalrymple: Tektronix **A High Performance Workstation Using a Closely Coupled Architecture** — B. Hamilton, M. Fischer: Syte Information Technology **Achieving High Performance in a High Resolution Graphics Workstation** — P. Harris: Jupiter Systems, Inc.	**SESSION 19: COMPUTER (** Chairperson: A. Ishizuka, J **Practical 3-D Solid Wire Mo** Shozo Oikawa: Mitsui E Shipbuilding **Graphics and Animation at** Kaneko: Japan Comput **To Be Announced** — M. Ishimura: Yamaha
SESSION 12: HARDWARE-SOFTWARE SYSTEMS FOR VERY LARGE SCALE INFORMATION RETRIEVAL Chairperson: L. Hollaar, University of Utah **Searching Large Files of Scientific and Technical Information** — N. A. Farmer: Chemical Abstracts Service **Hardware-Software for Very Large Information Retrieval** — J. H. Bryant: United States Patent and Trademark Office **A Message-Based Information Handling System** — L. Hollaar, S. Robison, M. Zeleznik: University of Utah	**SESSION 16: LEGAL ISSUES** Chairperson: E. D. Manzo, Cook Wetzel & Egan Ltd. **Copyright and Other Forms of Protection for Software** — S. Nycum: Gaston Snow & Ely Bartlett **Profitably Protecting Programming: Patents, Trade Secrets, and Licensing Software** — M. Ishimaru: John Fluke Mfg. Co., Inc. **Does Your Programmed Computer Infringe the Patent?** — E. D. Manzo: Cook, Wetzel & Egan, Ltd.	**SESSION 20: HEALTH AND COMPUTERS** Chairperson: M. Smith, Na Occupationa **Visual Factors and VDT Use** University of California **Muscular Effects of VDT Wo** National Institute for O and Health **Video Display Terminals: Is Hazard?** — W. Murray: N Occupational Safety an **Mental and Emotional Issue** M. Smith: National Insti Safety and Health

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Thursday, March 1, 1984

0pm	8:30–10:00am	10:30am–noon	
OCC PUTERS Cor uter Science sor — D. Stevenson: — F ateosian: or -W. N. Johnson: pat e Microprocessor Digt Equipment Corp. **RIAL ON IEEE E-MAIL** **III) tails on last**	SESSION 21: NEW VERY-HIGH-END ARCHITECTURES I Chairperson: Y. Patt, University of California **TRAK: Environment for Parallel Computing** — J. C. Browne: University of Texas **VLIW Machines: Multiprocessors We Can Actually Program** — J. Fisher, J. J. O'Donnell: Yale University **CEDAR** — D. Lawrie, D. Gajski, D. Kuck, A. Sameh: University of Illinois	SESSION 25: NEW VERY-HIGH-END ARCHITECTURES II Chairperson: J. R. Goodman, University of Wisconsin **Avoiding Serial Bottlenecks in Ultraparallel MIMD Computers** — A. Gottlieb: New York University **SIMD and MSIMD Variants of the Non-Von Supercomputer** — D. E. Shaw: Columbia University **The Aquarius Project** — A. Despain, Y. N. Patt: University of California	SUPER COMPUTERS (Cabernet II)
NETWORK STANDARDS MPL ENTATIONS ekt ix Inc. rds R. Blanc: NBS LAN, the "EASYWAY" — ble Computers nen ion Considerations l Da Systems d LAN Protocols — Tools rification — I. Singh: da zation Within Hu es. R. Floyd, G. C. ors Corp.	SESSION 22: SOFTWARE MAINTENANCE: METHODOLOGIES AND EXPERIENCES Chairperson: N. Schneidewind, Naval Postgraduate School **Software Manufacturing and Large Software Maintenance** — D. Marca: Softech, Inc. **Use of Model VHLL in Software Development and Maintenance** — B. Szymański, E. Lock, N. Prywes: University of Pennsylvania **A Graph-Based Software Maintenance Environment** — S. S. Yau, J. P. Tsai: Northwestern University	SESSION 26: DEVELOPING MICROPROCESSOR STANDARDS Chairperson: M. Smolin **The Futurebus Project** — P. Borrill: University College London **The STE Bus Project** — B. Shields: Seaport Computer Systems **The VMEBus Project** — W. Fischer: Motorola Semiconductor **The Microprocessor Operating System Interface Project** — D. Jackson: Motorola, Inc. DW160 **MUFOM: A Standard Relocatable Code for Microprocessors. What's It Good For?** — T. Pittman: Itty Bitty Computers	SOFTWARE SYSTEMS (Cabernet I)
GR HICS IN JAPAN JC del for Piping Design — Engineering and JC — Mitsuru ter aphics Laboratory	SESSION 23: DATABASES FOR CAD/VLSI Chairperson: R. Katz, CS Department **Towards VLSI Design Systems Using Relational Databases** — G. Hallmark, R. A. Lorie: IBM Research Laboratory **Information Management for CAD/VLSI Applications** — D. J. McLeod, K. Narayanaswamy, K. V. Bapa Rao: University of Southern California **Recovery of In-Memory Data Structures for Interactive Update Applications** — S. Weiss, R. H. Katz: University of California	SESSION 27: CAD/CAE ON PERSONAL COMPUTERS: TOOLS OR TOYS Chairperson: T. Blank, Stanford University **PC's and Mainframes Automate Electronic Design** — B. Gladstone: Futurenet Corp. **Micro-Cap: An Analog Circuit Design System for Personal Computers** — A. Thompson: Spectrum Software **Personal Instrumentation in the 80's: A Revolution** — J. Fischer: Northwest Instruments Systems Inc.	WORKSTATIONS & VLSI (Cabernet III)
S ETY ISSUES OF A VDTS ati al Institute for al Safety and Health e — L. Stark: a ork M. Smith: Occ pational Safety **There a Radiation** Na onal Institute for nd ealth es VDT Work — titute for Occupational	SESSION 24: COMPUTING FOR THE HANDICAPPED Chairperson: G. I. Davida, University of Wisconsin-Milwaukee **Toward Sensor Driven Manipulation for the Disabled** — L. Leifer, U. Elsasser, S. Michalowski: Stanford University **Networks for Deaf-Blind People** — R. E. Ladner, B. Wagreich: University of Washington **Disability Independent Computer Systems for the Handicapped** — G. I. Davida, J. Livesey, E. Desautels: University of Wisconsin-Milwaukee	SESSION 28: INNOVATIVE DISPLAY TECHNOLOGIES Chairperson: J. Rudolph, Oscco Ventures **Active Matrix Addressed Liquid Crystal Displays** — T. Maloney: Panelvision **Innovative Display Technology — Why a Flat Panel When You Can Have a CRT?** — M. Zuckerman: Crystal Vision **Active Matrix Liquid Crystal Displays Using Amorphous Silicon Thin Film Transistors** — F. Flasck, S. A. Holmberg: Alpha Sil	APPLICATIONS & POTPOURRI (Sauternes I/II)

(continued on next page)

REPORT ON THE COMCON CONFERENCE San Francisco, February 1984

Introduction

Comcon is an annual conference sponsored by the Institute of Electronic and Electrical Engineers (IEEE). The conferences have central themes and the papers address aspects of this theme. The intention of the conference is to present an overview of emerging issues and technologies at an intermediate level. In this respect Comcon is a conference version of the proceedings of a learned society rather than their transactions.

The informing theme of this year's conference was Intellectual Leverage - The Driving Technologies: that is to say, technologies which facilitate and expedite a variety of scientific, industrial and commercial applications and enterprises. An alternative description of the conference could have been the infrastructure of the emerging technologies.

General Observations

About a hundred and twenty papers were presented to more than three thousand registered attendants. The largest foreign contingent, consisting of about a hundred, was from Japan. There was also significant representation from the U.K., Germany, Italy, and France. We noticed a number of representatives from Korea, Greece, China, India, and Singapore.

In addition to the authors, the Canadian delegation consisted of two assistant professors of computer science from the Universities of Guelph and Windsor. Neither of their universities have graduate programs in computer science or engineering.

Of the American attendants about two-thirds were from the private sector, the majority from small and medium-sized companies. The remaining third was almost equally divided between academia and government departments, agencies, and laboratories.

The contrast between Comcon and the annual Canadian IEEE Conference deserves comment. For the most part Canadian conference attendees spend their time inspecting the exhibits while the technical sessions are attended by undergraduate and graduate students and a few representatives from the research and development departments of large, and usually foreign-owned corporations. The representatives of small Canadian companies devote themselves to their display booths and making customer contacts. Since most of them are engaged in cloning, counterfeiting or distributing American products, and their future development plans, if they have any, involve incremental improvements rather than radical innovations, they would consider the range of Comcon topics as too abstract and ambitious ("blue sky") to merit serious attention.

The most striking contrast between Canadian and American conferences is one of mood. The attendants at Comcon radiate optimism and an attitude of technical adventure and enterprise. One could sense that the Americans believed that what they were doing was exciting and significant and that they were having fun doing it. The Canadian mood oscillates between gloom and doom. We are involved with nuts and bolts, with finding a small secure niche, with the problems of survival in a technologically hostile environment. The level of intellectual speculation at a gathering of Canadian high tech companies is barely above that of a haberdasher's convention. Whether this mood is the cause or consequence of the parlous state of advanced technology in Canada has, of course, been the subject of perennial debate.

Corridor Discussions

Corridor discussions and industry gossip are important aspects of these technical gatherings The order of the comments below is not intended to indicate their relative significance.

1) The economic and technical dilemmas of the mini-computer industry in general, and DEC (Digital Equipment Corp.) in

particular, was the subject of considerable discussion. DEC is the second largest computer manufacturer in the world. Others in the mini-computer field include Data General, Hewlett Packard, Tandem, Prime, and about twenty other companies. They are all caught in the squeeze between the downward trend in main frame cost and the upward trend in the power of micro processor-based personal computers. As a consequence they have been compelled to reduce their prices while at the same time providing more computing power. Worse still, each increment in power requires progressively greater and more expensive research and development; the law of diminishing returns seems to have come into play. The net result is that the number of mini systems sold is increasing slowly while the profit per unit sale is rapidly declining. There are now apparently serious debates inside DEC as to whether they should concentrate on extremely sophisticated software systems to be, effectively, built into their hardware products as an alternative to their present strategy.

2) Artificial intelligence and expert systems have become pervasive themes in the computer and data processing industry. It is the general consensus that in one form or another expert systems will constitute at least a large, if not the largest portion of the data processing market for main frames and personal computers. There is every reason to believe that the transient enthusiasm for "computer literacy" will fade as convivial expert systems, as easy to use as the telephone, arrive on the scene. Such systems will be employed for home medical diagnosis, automobile repair, business decisions (in conjunction with integrated software packages such as Lotus 1,2,3), facilities management, production, planning, and a variety of other applications.

3) Super computers exceeding by more than two orders of magnitude the processing power of the Cray-2 have become a subject of paramount concern in the scientific and engineering communities. Conventional computer architectures (Von-Neumann) present insuperable barriers to such an increase in power. For a multitude of problems in pure and applied physics, such as aircraft simulation, particle physics, cosmology, weather forecasting, and neurological modelling, a vast increase in power is crucial. There is the widespread conviction that super computers will provide a tool whose impact will be comparable to that of the microscope, the telescope, and the spectrometer, on biology, astronomy and chemistry. For example, the solution, in quasi-real time, of the multi-channel Schroedinger wave equation would make it possible to perform most, if not all, chemical and metallurgical experiments on a computer.

There is no research on super computers in Canada though several Cray computers have been purchased. In the U.S., applications such as anti-ballistic missile systems and war game simulations provide a major source of funding for research in this area.

4) Parallelism is the major issue in computer architecture, particularly for artificial intelligence applications. There is the widespread conviction that interesting and practical applications in machine reasoning and inferences will not evolve until radically new approaches to computer architecture are taken. These approaches could employ co-operative communities of thousands and even tens of thousands of computers, each computer with the power available a few years ago on hundred thousand dollar machines. In a few years time VLSI (very large scale integration) powerful single chip computers will cost no more than a few dollars, and will be available for assembly in

parallel processing computers, according to senior Motorola and Intel sources.

It would not be unreasonable for Canada to undertake such a project. Likely a number of Cray class computers will be acquired by government departments over the next decade. The cost of developing a prototype system would exceed by a factor of at most three the cost of single system purchase and at the same time would provide at least the possibility for further sales. The personnel involved in the development effort would obtain invaluable experience and become a national resource.

5) It was generally acknowledged that optical memories would almost certainly supplant magnetic memories over the next decade. The rumour mill has it that IBM has placed very large orders with a number of unnamed Japanese second-tier manufacturers for an optical storage peripheral. The specification for the device according to some "unusually reliable sources" was developed in IBM's Tucson development laboratory and is based upon an existing operational prototype system.

6) There is some concern about the viability of the personal computer business. Although there is little doubt that large scale purchases by businesses will continue for at least the next few years, the consumer market appears to have peaked. The bloom is off the rose as far as the casual user is concerned: as many computers are to be found in closets as in use. The educational market is also declining for lack of appropriate software and because of the reservations and fears of the teaching profession. At present a large proportion of new system sales are to users who are replacing first generation systems dating from 1977. The number of sales to first time users is not increasing.

The large publishing and retailing structure that has developed around PCs appears to be in more imminent danger of collapse than the manufacturing companies.

7) The MacIntosh (Apple), in spite of its limitations (lack of expansion capability), has been welcomed by the computer community. The fact that it is outselling the IBM Jr. is encouraging for other manufacturers. This success is also seen as a wedge which may alter the technologically conservative posture of the industry; a posture which IBM has been able to impose through the virtual monopoly it enjoys in the main-frame environment.

8) Large scale information retrieval is emerging as an area of major importance. The work has been given encouragement by very large pending contracts from the U.S. civilian and military agencies (National Security Agency, U.S. Patent Office, Library of Congress, etc.).

9) A number of new technologies which have been either dormant or restricted in their application will likely become large scale, low cost commercial products in the next three of four years. These include high resolution flat screens, high speed ink jet and laser Xerographic printers, and high resolution document scanners.

Major Addresses

There were two major addresses. The first was by Gordon Bell, the former executive vice president of DEC who is generally given much of the credit for DEC's success. Dr. Bell was also the source of a number of remarks relating to DEC's future. These remarks were prefaced with "just between us" but the "us" usually included at least a dozen people.

The theme of Dr. Bell's speech and the lively discussion that followed was why the various computer architectures, that have been the subject of university research over the past decade, have had no significant impact on the industry. Since Dr. Bell's career has been divided between industry and academia, his observations are particularly pertinent. He claims that:

1) The new computer architectures are not readily adaptable to the massive existing software base.

2) They are not focused on application areas where the absence of an existing system or the manifest inadequacy of existing systems would enable them to establish a defendable beachhead.

3) The transition from concepts and breadboards to practical engineering has been largely ignored.

4) The scope of an academic project is circumscribed by the availability of doctoral students. The priority in such an environment is invariably on publications, not products. The periodic departure of personnel to other institutions disrupts and often destroys the coherence of a project.

Dr. Bell sees some possibility of new architectures ultimately displacing the Von-Neumann model which is inadequate to the rising needs of: logic and functional programming, large scale transaction processing, and computationally intensive problems in economics, physics, and chemistry. Still another promising development is the ability to rapidly design and fabricate custom very large scale integrated circuits with wafer scale integration, by employing VLSI design stations. This will make it possible for small firms to move rapidly from concept to hardware implementation.

The second keynote address was given by Larry Sumney of the Semiconductor Research Corporation. SRC is a co-operative research organization along the lines of Admiral Inman's MCC (Micro-electronics and Computer Corporation). Its participants include many large semi-conductor manufacturers. Bell Labs, Western Electric, and IBM are absent from the list, though IBM has a de facto presence through its equity position in Intel.

The mandate of SCR is to advance the frontiers of integrated circuit capability. Sumney comes to the presidency of SRC from a former position as head of the 300 million dollar U.S. Defence Department VHSIC program (Very High Speed Integrated Circuits).

Among the immediate aims of the SRC are:

a) Automated design tools to reduce the time required to design complex chips with several hundred thousand components from twenty man-years to a single man-year.

b) The improvement of yield through entirely automated production and test facilities.

c) The reduction in line width from the prevailing industry standard of three to five microns to a half micron, by the use of x-ray and other exotic lithographic techniques. This will result in an approximately hundredfold increase in the component count so that the semi-conductor real estate that now holds 64000 bits of memory could accommodate almost six million bits.

d) Wafer scale integration permitting systems with six hundred million components to be made as a single component.

e) An increase in speed of an order of magnitude for commercial devices from about 50 nanoseconds to under three nanoseconds.

A Cray computer could easily be constructed on a single wafer with these new technologies.

The SRC model should be carefully examined in Canada. If major corporations, many larger than Nortel, believe that a co-operative endeavour of this sort is essential to their survival, then the federal and provincial governments' efforts to introduce micro-processors to industry through the various technology centres is obviously too little and too late. It may be necessary to launch a co-operative public-sector-private-sector venture if Canadian high technology companies are to survive. The steps from the component to the complete system are becoming fewer and smaller, and may vanish over the next decade. Without a presence in the component area we find ourselves unable to compete in the systems and software areas.

Conference Papers

The following account is intended to convey the flavour and thrust rather than a comprehensive summary of the papers presented at the conference. Wherever appropriate we have briefly commented on the possible significance of the work and its implications for Canadian scientific and industrial policy.

The conference was divided into three occasionally overlapping major areas.

1) Super Computers: Included in this area were numerical super computers, unconventional architectures, principally directed towards artificial intelligence applications, as well as super microcomputers. Papers in this area also discussed associated software issues and such frontier areas as molecular computing and the application of biological materials.

   It is significant to note that very little work in any of these areas is underway in Canada. Some notable exceptions are the high speed ancillary computational engines developed in the physics departments of the Universities of Toronto and Waterloo, the Tree machine and the Systolic loop architectures at the University of Waterloo, one data flow architecture simulation thesis at Toronto, and an interesting proposal for a Prolog machine from Acadia University.

2) Software Systems: The papers in this area included new non-procedural languages, expert systems, MODULA the presumed successor to Pascal, Unix, an operating system which its proponents believe will become the de facto standard for personal computers, and more mundane issues relating to software, maintenance, and standards.

3) Work Stations and VLSI: These sessions covered office automation and dedicated work stations for the design of special VLSI devices. Papers in these sessions included such issues as the translation of software into hardware, and two papers which compared and contrasted optical and magnetic storage techniques. These papers were delivered by IBM personnel who in the past have been either critical or skeptical of the claims made for optical storage. The question contained in the title of the session "Magnetic vs Optical Storage - a New Ball Game?" was answered in the affirmative: it is a new ball game.

A fourth session, which was a potpourri of areas and applications, dealt with video discs, laser printers, information retrieval, legal issues in software protection, display technologies, the U.S. Air Force STARS project, VDT safety, authorship systems, and computing for the handicapped.

Super Computers

The first paper in this session, by N.R. Lincoln of Control Data, was a critique of some claims made for the next generation of super computers. Since Control Data's domination of the market has been eroded by first and second generation Cray systems and is threatened with extinction by the super computers Hitachi and other Japanese companies have recently introduced in Europe, the paper's skepticism conveyed a sense of big company conservatism, and the sour grapes of an organization that has recently lost a number of major clients.

The second paper, describing the need for super computers in the area of aerodynamic simulation for aircraft missiles and automobiles, was delivered by W.F. Balhaus of NASA.

In 1972 eighteen hours of computation were required to simulate a wing. By 1982 the entire aircraft could be simulated in fifteen minutes. Real time simulation of flight maneuvers is still not computationally feasible. The core problem is the real time approximate solution of the classical Navier-Stokes equation, perhaps the central problem in applied mathematics. The cost of the super computer is justified by the safety, and the cost effectiveness of computation compared to wind tunnel and flight tests. A new super computer is to be constructed under the auspices of the Research Institute for Advanced Computer Sciences, formed by NASA, and operated under contract by the University Space Research Institute. The new system will be a central facility and provide remote access to scientific workers through special dedicated work stations.

The model deserves consideration by Canadian funding agencies. In many ways it is similar to a particle accelerator facility for the nuclear physics community.

Data Flow Architectures for super computers were discussed by the principal proponent of this architecture in the U.S., Jack Dennis of MIT. The data flow concept effectively simulates the flow chart of a computer program by employing a computer in each node of the computational graph. It allows a considerable measure of parallelism and is one of the central development areas of Japan's fifth generation program. Almost every major U.S. university has a research program in the hardware and software aspects of data flow architecture. Although the concept is discussed in graduate and undergraduate courses in Canada, to the best of our knowledge, only one M.A. thesis in the area is underway in Canada .

Concurrent Processing for Scientific Calculations by G. Fox of Cal. Tech. surveyed a wide range of applications in many areas of science and technology that are effectively stalled for lack of adequate computational power. These problems include theoretical chemistry, physics, cosmology and geophysics and applied areas such as: structural analysis, chemical synthesis and image interpretation. The argument was made that super computers and algorithms tailored to their architectures are analogous to the microscopes, telescopes and spectrometers needed for the major scientific breakthroughs of the 19th century. The work on a 32 node multi-processor system employing conventional micro processors at Cal. Tech. was described, and plans for a 1,000 and 100,000 node machine employing advanced micro-processors were outlined.

A number of U.S. and European universities are active in this area. There is no comparable activity underway in Canada.

A paper by C.A. Arnold of ETA systems of St. Paul, Minn., a very small company, discussed their super computer project and the software algorithm and memory management issues involved. The program is funded by DARPA and has attracted considerable venture capital.

Fisher and O'Donnel of Yale discussed the Bulldog compiler for their ELI (Enormously Long Instruction) machine. The compiler extracts the parallelism inherent in programs which in conventional computer languages are either linear or hierarchial in structure. In Canadian universities such concepts receive a theoretical analysis and are then abandoned when the doctoral candidate moves on. Yale by way of contrast has a sustained long term team effort to develop both the hardware and software required for the system.

D. Gajski of the Laboratory for Advanced Supercomputers discussed another novel and unorthodox system under construction at the University of Illinois. This system will employ a very large number of special purpose VLSI devices which communicate through a large central switch. The system is still in an early phase and is supported by government funding which probably exceeds for this project alone all Canadian government funding for hardware-oriented university projects. The university is actively soliciting industrial partners with the assistance of external consultants.

David Elliot Shaw of Columbia, whose work was described in a recent issue of Fortune Magazine, discussed his massively parallel non Von-

Neumann architecture for A.I. and data base applications. Shaw, an old friend, indicated in private conversation that he has received inquiries from Alberta-based venture capital companies.

The Aquarius Project at the Berkeley campus of the University of California is a hardware and software effort involving ten full-time researchers and a support staff, in the development of hardware and software for a system which will combine facilities for efficient symbolic and numeric operations. There are considerable problems in combining these two facilities which have contending hardware and software requirements. At the same time there are considerable advantages to be gained by combining the two. One such application is an "expert mathematician" system which could be of inestimable value to engineers and physicists in every application area.

A number of other papers dealt with theoretical issues in very high end architectures. Among them Gotlieb of the Courant Institute discussed methods of increasing parallelism on the Ultra computer under development at the Institute. Hewitt of MIT discussed the Apiary concept of a large number of "worker units" engaged in autonomous yet co-operative computational tasks. Finally, Ullman of Stanford, perhaps the premier theoretician in the computer field, discussed some of the theoretical issues emerging from his research. According to Ullman, the central issue in designing massively parallel machines is their ability to sort.

Although this paper was profound and insightful, it requires recourse to symbolism to be properly explained. Ullman showed how "joins" in relational data bases are equivalent to logical inference. This feature alone demonstrates the inadequacy of conventional architectures for AI applications.

Super Micro Computers

Papers on super micro-computers were presented by Zilog, National Semi Conductor, DEC and Bell Labs. It appears likely that Bell will soon introduce a Unix-based super micro processor. Opinion at the conference was almost equally divided about the possibility and prospects for this venture. One school of thought argued that Bell will be a strong IBM competitor for the high end of the personal computer market. The Bell papers described advanced memory management architectures for 32 bit CMOS processor with special features to embed and enhance the UNIX operating systems.

Ownership of UNIX, the ability to manufacture 256K bit memories and VLSI processors in its Western Electric facility, and the potential for capturing the business of the new regional telephone companies, provides Bell with significant strategic advantage.

The architectures described by DEC were a chip set for the popular VAX architecture, and a smaller single chip version which executes most of the VAX instruction set with the remainder simulated infirmwave. Since the VAX is the workhorse of a large part of the AI community, the appearance of a VAX, likely at a third the cost of existing systems, should be a boost to AI research. The micro-VAX should make it possible for personal computer users to avail themselves of the powerful VAX software, in AI and image processing, for sophisticated low cost research projects.

Canadian university and government laboratories who have rented VAX systems or who have them on order should review their procurement policy with respect to these new developments.

The Zilog and National offerings are powerful but conventional single chip systems. The effective computational power of either systems exceeds that of the largest main frames available in the early seventies. These systems will be available in late 1984 with a board level cost of about $200.00 (Canadian).

The National offering is the first commercial 32 bit CMOS (very low power) commercial processor. It is interesting to note for those who doubt that a small country like Canada can develop a comple VLSI computer, that the national 16000 computer family architecture was developed and put into silicon at National's Semiconductor's facility in Israel. It is widely considered to be the most advanced micro-computer in the industry.

Molecular Computing

Molecular computing offers the possibility of achieving an increase of more than four orders of magniture in device density and an equally large reduction in power consumption (10^{18} devices per cc).

In a related area, employing biological components and "growing" computing systems suggests the long term possibility of producing powerful computers for fractions of a cent.

However attractive the long term prospects may be, the probability of realizing complex systems, or even simple demonstration devices in the next five years is very small. Research on these devices require the synthesis of many disciplines ranging from organic chemistry to quantum chemistry. Problems related to quantum tunneling and Soliton transmission must be solved at a time when they are just beginning to be understood. When one considers that the physics of the Soliton (a Soliton is a non-dispersive pulse which propagates through a dispersive medium; a tidal wave is a large Soliton) has not received a satisfactory treatment, despite being the object of investigation by some of the world's leading mathematicians for twenty years - the difficulty of the problem becomes evident.

Although a number of research projects in this area are funded by DARPA and ONR the realistic prospects for the next ten years are limited to proofs of feasibility.

The wisdom of working on switching devices in the biological realm can be questioned. Computing in biological systems almost certainly employs entirely different principles than those used in digital computers. The achievement of greater device density may not be effective unless entirely new organizational and algorithmic procedures are devised.

Breakthroughs in computing may come by way of the neurosciences which could suggest new architectural principles. These principles could be executed in silicon or bio-chips. The crucial problem in biological computing is the organization of the system rather than the fabric of the system. For a long time to come neurology will have more to offer computer science than biochemistry.

Software Systems

The most interesting session in this section was entitled From Logo to Logic Programming. The three lectures covered Logo, a Lisp-based language (in the profession it is called Lisp for losers) which has found strong advocates in the educational community. Lisp is the language of the AI community in the U.S. (which according to its critics stands for Lots of Silly Parentheses). The two other papers were on functional programming and logic programming.

At present the major commercial computer languages—Fortran, Cobol, Basic, Pascal, Ada—are so-called 'procedural languages'. They provide a set of commands whose sequence is critical to the solution of a given problem. Non-procedural languages fall into two categories: functional and relational.

Procedural languages are prescriptive in that they prescribe the manner in which a problem must be solved, and as such are tied to the structure of the conventional digital computer. Functional languages, of which APL is an example, describe a problem as a set of mathematical functions which return values. A set of functional operators comprise the syntax of the language. John Backus, the chief architect of the Fortran and

AlgoL languages, has argued persuasively that any significant advance in computer science demands that procedural languages be abandoned in favour of functional languages, and that an entirely new computer architecture must be designed to accommodate these new languages. Backus is not a wild-eyed dreamer; he is a senior executive in IBM and conscious of the vast investment in standing software that effectively would be rendered obsolete by such a change. He believes, however, that the cost of software production and maintenance has become an intolerable burden and that heroic measures are essential to resolve the crisis.

The relational languages are best exemplified by logic programming which employs the syntax of the first order predicate calculus. In the past few years a modified version of the calculus employing Horn clauses has been converted into a language called Prolog. The main advantage of programming in Prolog is that it is a descriptive non-procedural language. Rather than providing a set of commands for solving the problem, a description of the aspects of the problem to be solved is written. Relational languages do not depend on the order of the statements. The computer then uses the knowledge to solve the problem. There are profound problems in describing problems adequately in a logical formalism (this area of research is called knowledge representation), and in deriving computer architectures which can efficiently manipulate logic expressions.

Until recently the Europeans and the Japanese have been enthusiastic proponents of Prolog while the Americans have been extremely skeptical. It now appears that Prolog is gaining increasing acceptance in the U.S.

In this area, Canada can boast world-class expertise. Martin Van Emden of Waterloo is considered one of the leading authorities on logic programming and has worked with Kowalski of Imperial College and Collmeraur of Marseille University on the original development of Prolog. Ray Reiter of UBC, is one of the world's leading logic theorists, and Pietrokowski of Acadia has investigated the architecture of a Prolog computer.

Remarkably enough the best current version of Prolog was developed in Hungary and the U.S. Department of Defence is one of the foremost customers for the language. Recently a Toronto company called Logicware purchased the license for the Hungarian Prolog and is developing a series of expert systems in that language.

Expert Systems

A system called CARE developed at the Indiana School of Medicine was described. It has direct access to patient data and employs about 1500 knowledge rules. CARE has been under continuous development since 1975. Dr. McDonald, the principal investigator quoted Samuel Johnson's adage that "Man more often needs to be reminded than informed." The CARE system uses its knowledge base of rules and facts to analyse the records of patients who are scheduled for appointments the following day and to suggest (or remind) the attending physician of the tests he should perform. The system then produces a number of tentative diagnoses. Unlike Mycin, the oldest medical diagnostic system, and possibly the most effective, it does not justify its diagnosis or weight its conclusions. CARE includes some powerful computational resources which the physician can employ to compute functions such as cardio-vascular risk, or to perform a regression analysis on tests made over time and stored in the patient's record.

Control studies have established that physicians employing CARE performed appropriate preventative medical tests twice as often with computer assistance as a control group without computer assistance. Efficient preventative screening seems to require computer scheduling.

With the steady increase of medical costs and an aging population, expert medical systems of various levels of sophistication could contain the explosive increase in the cost of delivering medical services over the next decade.

To the best of our knowledge only John Tsotsos at the University of Toronto, Ernie Chang at Victoria, and their students, are involved in the development of expert medical systems.

A second paper on medical expert systems described work on converting MYCIN from its existing rule-based architecture to a logic programming environment. The investigators at RAND appear to be convinced that logic programming affords considerable advantages.

From the comments of the participants one could not fail to draw the conclusion that the principal thrust of AI research and development will be in the area of logic and in the hardware architectures which facilitate logic programming.

Other Issues

Modula - Modula is an extension of PASCAL, one of the most popular programming languages (after BASIC) for personal computers. It also contains a number of features of C which has rapidly gained acceptance in the UNIX operating environment. Unlike ADA, the official U.S. Armed Forces computer language, MODULA has not entered the world with the promise of an assured acceptance by a large captive market. It might, in time, form a bridge between the PASCAL and C software communities and largely supplant them both.

Modula is the latest in a long and continuing trend to produce specification-based languages. There is a Tower of Babel problem in computer languages; new languages continue to proliferate and old languages never quite become extinct. Significant increases in programmer productivity are unlikely to emerge from developments such as MODULA.

UNIX, local area networks, and bus architectures and standards were discussed in a number of papers. Briefly UNIX is the operating system of choice of most sophisticated users of personal computers. Although IBM has provided university laboratories with UNIX-based systems, it has not given UNIX its official blessing. This step is likely in the cards and every other personal computer manufacturer will follow this lead.

Bus and local area standards are not likely to be adopted for some time. Standardization is one of the worst things that could happen to the personal computer industry at this time. It could arrest progress and abdicate for the foreseeable future any hope of challenging IBM's advantage. With change there is hope and standards inhibit change. Significantly, the most general bus architecture, the VME bus, appears to have a strong Motorola bias. Motorola micro processors are not used in the popular IBM system.

Workstations and VSLI

The session on office automation was uninspired.

A paper with many authors from the University of Delaware made the point that automated office procedures had to be "trustworthy and reliable" in order to gain widespread acceptance. A number of other equally profound remarks on user privacy and the functions of an automated private secretary followed.

A fanciful paper entitled "A 1990 Scenario, Personal Augmentation" from the Diebold Group sketched out a day in an executive's life in 1990 with voice recognition, video conferencing, computer-assisted decision making, and the assorted gadgetry and gimmicks familiar to the reader of sixties science fiction stories.

The only significant paper in the office automation session described a new Hewlett Packard document scanner which holds the document stationary, and which permits the scanning of large area documents such as maps and charts. By using a pre-scan mode, the system first determines the parts of the document that must be scanned at high, low, and medium resolution. This procedure reduces the overall scanning time as well as the bit storage required for the document.

The various work stations described combined very high resolution screens with advanced vector processing hardware. With the possible exception of Orcatech there is no manufacturer of sophisticated work stations in Canada. Recently at least three federal government requests for proposals have appeared which involve large scale procurement of advanced work stations. Consideration should be given to fostering and funding one or more indigenous suppliers of these systems.

Computer-Aided Design & Computer-Aided Education on Personal Computers

Sophisticated simulation software is becoming available for both analogue and digital systems, which will run on personal computers. These systems effectively reduce the time and effort required for analysis and breadboarding by several orders of magnitude. They also provide effective tools for updating, trouble shooting, and debugging designs. The next generation of 32 bit micro-processors equipped with memory management hardware and high speed arithmetic co-processors should enable extremely sophisticated design software to operate in real time. This will, for example, allow small companies to design and simulate complex VLSI digital and analogue systems as well as larger systems composed of these VSLI modules. It follows that an infant company can attack system projects which formerly required the efforts of a twenty-man engineering team.

The immediate applications for these simulation systems is in engineering schools. Academic circuit and systems analysis still concentrates on only the most elementary networks. Most engineers never employ these techniques because the networks they encounter in practise are far too complicated. The new simulation tools should be introduced to the student in his undergraduate years. Simulation and analysis of systems with the emphasis on the interpretation of results, rather than tedious exercises in the manipulation of matrices and contour integrals, should be a central theme of engineering training.

Canadian companies should be encouraged to develop computer-aided design software rather than concentrating on the virtually saturated business software market.

Magnetic vs Optical Storage

although the current inability to erase from optical data disks limits their application to certain areas, their greater data storage density, much lower cost, and greater reliability, assures them of a market that is at least as large as the magnetic disk market. In addition, the ability to mass replicate optical disks by means of a pressing process is an outstanding advantage in the areas of distributed data bases, electronic publishing, and read only memory applications.

It is expected that eraseable optical disks based on the magneto-optical properties of their films will emerge from the laboratories over the next few years and effectively compete with magnetic disk in application areas requiring on-line up-dating.

It is likely that over the next decade a standard optical disk drive will be produced which will accommodate read only, direct read after write, and eraseable disks. These drives will dominate the mass storage market and susbequently the domestic entertainment market. The Sony-Philips type of compact laser disk will become the dominant audio recording playback system before the end of this decade. Entertainment video disks, and video disk magazines of a novel sort will proliferate in the late eighties. It is probable that eraseable optical disks will replace VTRs by the early years of the next decade.

Although federal optical data disk policy is currently being formulated, it is severely constrained by the level of risk that government funding agencies, and private sector companies, are prepared to entertain.

The level of funding required to develop and sustain a viable data disk industry through the development and market entry phase is large. It would not, however, exceed the aggregate expenditures on such problematic technological adventures as Telidon, the Spar Arm, the Tokamak reactor, and various satellite projects. It shrinks into insignificance compared to the F-18 acquisition. There is little doubt that the Canadian demand for optical data disks would sustain a company several times the size of Mitel. (See the papers by Hoagland and Bell.)

Hardware-Software Systems for Very Large Scale Information Retrieval

Hardware and software systems for large scale information retrieval have been urgently required in every area of industry and government for at least three decades. It is apparent that the storage, retrieval and manipulation of information constitutes the largest part of the wage bill of the advanced industrial nations, and acts as a crippling overhead that is supported by the entire economy. Within the past few years, optical storage, advanced retrieval techniques, and VLSI devices for the high speed search of large volumes of information have presented us with the opportunity to contain the ocean of paper that threatens to engulf us.

Nick Farmer of Chemical Abstracts described the architecture of their new multi database system. One of these data bases contains 6.3 million documents and is increasing at the rae of about half a million documents a year. These abstracts are about a hundred words long. Another, the chemical substance data base, is growing at the rate of about four hundred thousand substances a year. The system will provide a worldwide, interactive, on-line facility employing keywords, chemical formulae and organic structural formulae as search terms. For example, a chemist will be able to sketch (with a light pen) an approximate structure with, say, a hydroxl radical, a benzene ring, and few more bonds; and obtain a listing of all the known chemical structures that match the partial description.

Chemical Abstracts intends to employ the expertise acquired in developing this system to develop other large scale systems for industry and government. For example, they are bidding on an even larger storage and retrieval system for the U.S. Patent Office.

The Patent Office application was described in another paper. The crisis in the Patent Office is growing every day. Among its consequences are costly and protracted legal disputes and the ruin of companies and individuals whose intellectual property is being exploited and who have no legal recourse. About 110 thousand patent applications are received every year. The pending file contains about 400 thousand applications and the pending time is 25 months, and increasing.

Lee Hollaar, a leader in the information retrieval field, described a VLSI system for high speed search he has developed and will soon manufacture. Over lunch he told us about his business relationship with the University of Utah, which enables him to retain a majority interest in all technologies developed by his group during his tenures at Utah and Illinois. In effect, the university has taken the role of a venture capitalist. Hollaar owes his good fortune to the success of Evans and Sutherland which was founded by former University of Utah staff, after they were unable to negotiate an arrangement with the university. The university learned its lesson and has since succeeded in attracting a large number of academic entrepreneurs. This is another model that Canadian universities could benefit by emulating.

Innovative Display Technologies

The three papers on flat display panels were given by representatives of very small companies. There is a good reason for this: all the large U.S. companies (with the exception of one Exxon subsidiary) have abandoned the flat screen market to Japan. Since there are technological and economic reasons to believe that in the long term, one or more of the flat screen technologies will entirely replace the cathode ray tube, the U.S. behaviour is tantamount to a military surrender immediately after the first shot is fired.

The basic technical problem in flat panel display technology is large area integrated circuit technology. This is not to be confused with very large scale integration (VLSI). In conventional integrated circuit technology the problem is to engrave a million transistors on a square centimeter or less of silicon or galium. In large area integration the problem is to deposit five to ten million thin film transistors on a glass substrate which may range from several meters square in area for a wall display, to a sixteenth of a square meter for a portable terminal.

The problems are less difficult than those encountered in integrated circuits. Only the meagre level of funding over the past decade accounts for the lack of progress.

Canada has no activity in the flat screen area. One of the micro-electronic centres should seriously consider a major program in large area thin film transistor circuits as an alternative to developing customized gate array devices for clients who would often be better and more economically served by direct contact with a silicon foundry.

Authorship Tools

The next step in the evolution of word processing lies in the incorporation of what has been called "a critiquing system." Such a system might be considered an "expert editor" system.

The Epistle system, which has been under development at the IBM Watson laboratory, incorporates many features one can expect to see on the few word processing systems that succeed in surviving the impending industry crunch.

The curent version of Epistle addresses the problems of style, grammar and spelling. It checks agreement between subject and predicate. It remarks on sentences that are too convoluted or lengthy. It calls attention to double negation, awkward phrasing, split infinitives, excessive noun modifiers, repeated words where synonyms are more appropriate and the use of esoteric words, like "esoteric" when "fancy" would do. The system is particularly strong in recognizing punctuation errors such as superfluous or missing commas, the incorrect uses of the colon and the semi-colon.

The present generation of word processors were essentially designed to enable a secretary to rapidly edit drafts of manuscripts, to alter the wording, to make revisions and to personalize correspondence. The next generation of work processors are intended to improve the style and speed of composition by the authors of letters, books, and articles. Two revisions of a letter may involve a half hour's work by a typist and several hours of struggling, head scratching, and wordsmithing by an author whose time is four times as expensive. With a machine editor whose criticism is objective and confidential, the speed and quality of work is improved at the highest rather than the lowest level of the office hierarchy.

Canadian word processor companies such as AES and MICOM for a brief period were considered leaders in the field. They ignored the potential of AI techniques and refused to believe that PCs would reduce their market share. Though both companies will likely linger on the sidelines, their long term prospects are grim. The incorporation of advanced software such as Epistle and Lotus 1,2,3, could resurrect these companies, but products such as these require an imaginative leap that Canadian management seems quite incapable of making.

Systems like Epistle can do for the English composition what the pocket calculator has done for arithmetic. Versions of the system directed towards business letters, theses, technical reports, manuals, and laboratory reports could be of considerable use in developing basic writing skills in the primary and secondary schools.

Japanese Efforts

Discussions with Japanese investigators are never easy. The Japanese are reluctant to use the word "no." It is a national characteristic to attempt to agree about everything and this leads to frustrating discussions. "Are you building special VLSI devices for your inference machine?" was answered by "yes, next year." Will you sell these systems to Canadian companies received the answer "yes, they are only for Japanese companies."

The session on computer graphics emphasized the Japanese use of special VLSI devices which expedite the rapid construction of 3D imagery. The next generation of graphic work stations could well be a Japanese monopoly. Graphic stations with the capability of a sophisticated $18,000.00 Tektronix terminal will be marketed by Japanese companies for about $5,000.00 in 1985. Labour costs can hardly be blamed since the U.S. products are as often as not assembled off shore in countries with a much lower labour cost than Japan.

In the area of data flow architecture the Japanese are developing VLSI devices for the first generation of practical machines. In the U.S., the U.K., and other European countries data flow machines have been studied, simulated, and even constructed as laboratory toys, for more than a decade. The Japanese will have a practical data flow machine for experimental use within a year, having entered the field in 1982. Many of the questions relating to software and efficiency of the data flow architecture will be answered by the experiments with this machine. From what we were able to gather they will share their results with the computer community.

Peripherals, Etc.

Japanese companies will offer a range of low cost ink jet and Xerographic printers, page scanners and optical storage peripherals for personal computers and office automation applications. The CRT monitors, the power supplies, and the memories of most PCs are already of Japanese manufacture. We have then the paradoxical situation of an industry in which the U.S. supposedly has a large lead, in which about 70% of the hardware is Japanese, and 80% of the assembly and test is performed by off shore companies. The level of profit which companies such as IBM derive from personal computers is comparatively modest. Their domination of the market is based on psychological ascendency rather than technical superiority. It is not unreasonable that the Toyotas and Hondas will soon challenge the GMs and Fords of the computer world.

The software gap between the U.S. and Japan is a myth. The companies that sell software to IbM, are already discussing licences with Sony and NEC. Graphics, decision support, and symbolic mathematics software packages, available from Japanese sources are already comparable to U.S. products.