本田財団レポート　No.11

「ディスカバリーズ国際シンポジウム ストックホルム1979」の報告

このレポートは1979年8月13日～17日にストックホルム市のサルトフバーデン グランド ホテルで 本田財団が 開催した第4回ディスカバリーズ国際シンポジウムの会議内容をまとめたものです。

DISCOVERIES
international
symposium

Man and society– automated information processing

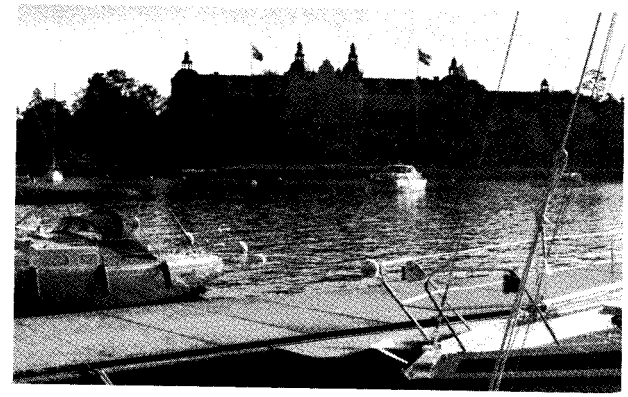
Stockholm
13-17 August 1979

Schedule
スケジュール

Opening session MONDAY, AUGUST 13

Chairman: Professor Gunnar Hambraeus

14.00–14.30	Opening Ceremonies H.M. Carl XVI Gustaf, King of Sweden Ambassador Masahisa Takigawa Minister Hans Blix Mr. Soichiro Honda
14.30–15.15	Keynote Address The Impact of Automated Information Processing on Society Professor Heinz Zemanek
17.00–17.45	Case Study Introduction Automated Information Processing in Medical Care Professor Sixten Abrahamsson



シンポジウムが開催されたサルトフバーデングランドホテル

The machines TUESDAY, AUGUST 14

Chairman: Professor Erik Sandewall

09.15–10.00	Lecture Impacts and Characteristics of Automation and Automated Information Processing Technology Professor Reikichi Shirane
10.00–10.30	Discussion
11.00–11.45	Lecture The State of the Art in Information Processing Professor Sidney Michaelson
11.45–12.15	Discussion
14.00–14.45	Lecture Long Range Prospects for Intelligence in Information Processing Systems Professor Edward Fredkin
14.45–15.15	Discussion Introductory comments: Professor Alwyn Scott
15.15–15.45	Case study Continuation Forecasting on Medical Resources and their Allocation by the Method of a Simulation Model Professor Kazuhiko Atsumi
16.15–17.00	Open discussion of the entire day Introductory comments: Professor Takemochi Ishii

ゼマネック教授の基調講演

The individual WEDNESDAY, AUGUST 15

Chairman: Professor Torgny Segerstedt

09.00–09.45	Lecture Automated Information Processing: Extending or Unbalancing Human Capacity? Professor Harold A. Linstone
09.45–12.15	Discussion of the Effects upon the Family Structure, the Household, the Work Place and Vocational Training Discussion Introductions: Professor Murray Eden Professor Kristen Nygaard Professor Yoichiro Murakami
14.00–15.45	Discussion of the Effects upon Primary and Adult (lifelong) Education Discussion Introductions: Professor Henri Tajfel Professor Zvonimir Damjanović Professor Richard Ichiro Emori
16.00–16.30	Case Study Continuation Health Care Program Docent Hans Peterson
16.30–17.00	Open discussion of the entire day

会議風景

Society and computers THURSDAY, AUGUST 16

Chairman: Professor Gunnar Heckscher

09.00–09.45 Lecture
Societal Implications due to Automated Information Processing
Professor Klaus Lenk

09.45–11.30 Discussion of Political Power through Computer Systems
Discussion Introductions:
Professor Ithiel de Sola Pool
Professor Shuhei Aida
Counseiller Politique Thierry de Beaucé

11.30–12.00 Case Study Continuation
Society and the All Comprising Medical Information System
Docent Hans Peterson

13.30–14.45 Discussion of Information Processing in the Public Sector
Discussion Introductions:
Deputy Director General Ingar Palmlund
Professor Umberto Pellegrini
Professor Toru Yoshimura

15.00–16.15 Discussion of the Implication for the Labor Market
Discussion Introductions:
Dipl. Ing. Fred Margulies
Professor Samuel Edward Finer

16.15–17.00 Open discussion of the entire day
Introductory comments:
Professor Toshiro Terano

Open session FRIDAY, AUGUST 17

Chairman: Professor Gunnar Hambraeus

10.00–10.30 Summary of Earlier Discoveries Symposia
Tokyo: Definition and Identification Studies on Conveyance of Values, Effects and Risks in Environmental Synthesis
Rome: On the Humane use of Human Ideas
Paris: Communication in Human Activity
Professor Eduardo R. Caianiello

10.30–11.30 Summary of Stockholm Discoveries Symposium
Man and Society – Automated Information Processing

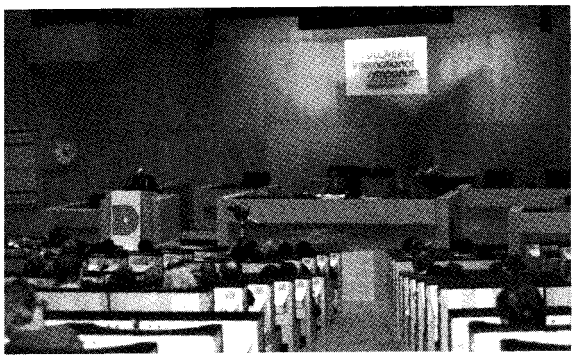
Case Study	– Professor Sixten Abrahamsson
The Machines	– Professor Erik Sandewall
The Individual	– Professor Torgny Segerstedt
Society and Computers	– Professor Gunnar Heckscher

11.30–11.45 Declaration of the Honda Foundation
Ambassador Takeso Shimoda

11.45–12.00 Symposia Accomplishments
Professor Gunnar Hambraeus

Social program

Sunday	12 August	17.00	Welcome Reception at Grand Hôtel, Saltsjöbaden
Monday	13 August	15.15	Reception given by Mr. and Mrs. Soichiro Honda
		19.30	Symposium Dinner at Grand Hôtel, Saltsjöbaden
Tuesday	14 August	19.30	Reception given by the City of Stockholm
Wednesday	15 August	19.30	Concert at Royal Palace
		20.00	Opera, Drottningholm Court Theatre
Thursday	16 August	18.15	Reception given by Japanese Embassy
		19.30	Dinner at Djurgårdsbrunns Wärdshus
Friday	17 August	12.30	Lunch given by the Royal Swedish Academy of Engineering Sciences



スウェーデン国会議事堂での閉会式

ハンベリュース実行委員長の閉会のあいさつ

IVAでの昼食会

Scientific committee

実行委員会

Chairman
Professor G Hambraeus
The Royal Swedish Academy of Engineering Sciences

Vice-chairman
Professor S Aida
University of Electro-Communications, Honda-Foundation, Tokyo

Scientific secretary
Professor H Lawson
University of Linköping, Sweden

Professor E Caianiello
University of Salerno, Italy

Professor S Abrahamsson
University of Gothenburg, Sweden

Professor G Heckscher
University of Stockholm, Sweden

Professor E Sandewall
University of Linköping, Sweden

Professor T Segerstedt
University of Uppsala, Sweden

Professor S Wikström
University of Lund, Sweden

Organizers

事務局

Bruce M. Adkins – reporter
France

Gunnar Hansson – organizing secretary
Royal Swedish Academy of Engineering Sciences, Stockholm

Eleonor Johansson – secretariat
University of Linköping

Birgitta Juhlin-Dannfelt – secretariat
Agma Office Service Stockholm

Shojiro Miyake – representative
Honda Foundation Tokyo

Yasuro Nakano – representative
Honda Foundation Tokyo

Martin Thorén – secretariat
Royal Swedish Academy of Engineering Sciences, Stockholm

Vaike Waher – secretariat
Agma Office Service Stockholm

Participants

参加者

Professor S Abrahamsson	Chemistry, University of Gothenburg, Sweden
Professor S Aida	Systems Science, University of Electro-Communications, Tokyo, Japan
Professor K Atsumi	Medical Electronics, University of Tokyo, Japan
Political Counsellor T de Beaucé	Political Science, Political Counsellor, French Embassy in Morocco
Professor E Caianiello	Physics, University of Salerno, Italy
Professor Z Damjanović	Life Sciences, University of Belgrade, Yugoslavia
Professor M Eden	Biomedical Engineering, National Institutes of Health, Bethesda, USA
Professor R I Emori	Mechanical Engineering, Seikei University, Tokyo, Japan
Professor S E Finer	Political Science, University of Oxford, Great Britain
Professor E Fredkin	Computer Science, Massachusetts Institute of Technology, USA
Professor G Hambraeus	Engineering Sciences, Royal Swedish Academy of Engineering Sciences, Stockholm, Sweden
Professor G Heckscher	Political Science, University of Stockholm, Sweden
Professor T Ishii	Systems Engineering, University of Tokyo, Japan
Professor H W Lawson, Jr.	Electrical Engineering, University of Linköping, Sweden
Professor K Lenk	Public Administration, University of Oldenburg, West Germany
Professor H Linstone	Systems Science, Portland State University, USA
Dipl. Ing. F Margulies	Engineering, University of Technology, Vienna, Austria
Professor S Michaelson	Computer Science, University of Edinburgh, Great Britain
Professor Y Murakami	Philosophy of Science, University of Tokyo, Japan
Director R Narasimhan	Computer Science, Tata Institute of Fundamental Research, Bombay, India
Professor K Nygaard	Computer Science, University of Oslo, Norway
Doctor L Obeng	Biology, United Nations Environment Programme, Nairobi, Kenya
Deputy Director General I Palmlund	Administrative Development, Swedish Agency for Administrative Development, Stockholm, Sweden
Professor U Pellegrini	Applied Electronics, University of Milan, Italy
Docent H Peterson	Medicine, Stockholm County Council Public Health Board, Stockholm, Sweden
Professor E Sandewall	Computer Science, University of Linköping, Sweden
Professor A Scott	Electrical Engineering, University of Wisconsin, USA
Professor T Segerstedt	Sociology, University of Uppsala, Sweden
Professor R Shirane	Electrical Engineering, Telecommunications Science Foundation, Tokyo, Japan
Professor I de Sola Pool	Political Science, Massachusetts Institute of Technology, USA
Professor H Tajfel	Psychology, University of Bristol, Great Britain
Professor H Terano	Control Engineering, Tokyo Institute of Technology, Tokyo, Japan
Mr. Y Tsutsumi	Science and Technology, Japanese Economic Journal, Tokyo, Japan
Professor S Wikström	Business Administration, University of Lund, Sweden
Professor T Yoshimura	Philosophy of Science, University of Saitama, Japan
Professor H Zemanek	Computer Science, International Business Machines, Vienna, Austria

人間と社会—情報技術の役割り

—ディスカバリーズ国際シンポジウム ストックホルム1979の報告—

電気通信大学教授 合田周平

1．スウェーデン国王の開会宣言

1976年10月、東京で開催されて以来、第4回目を迎えた「ディスカバリーズ国際シンポジウム」は、毎年1回、ローマ、パリと引き継がれ、学術の香り高いストックホルムで、1979年8月13日より5日間、スウェーデンをはじめ12ヶ国約50名の参加者を得て開催された。

開会式には、スウェーデン国王、グスタフ16世陛下を迎え、開会宣言とともに、つぎのようなお言葉を給わった。"……情報化社会はコンピューターの発展とともに、将来よりよき人類社会を構築するために貢献するであろう。今回の「ディスカバリーズ国際シンポジウム」は、コンピュータと社会を主題に、技術進歩の功罪をも総合的に論じるものであり、その成果と今後の活動に大いに注目している。"

ついで、スウェーデン国外務大臣、H.ブリック閣下の祝辞と講演があり、日本国内閣総理大臣からのメッセージが、駐スウェーデン日本大使滝川正久氏より伝達され、ストックホルムでの国際会議にふさわしい雰囲気をかもしだした。

主催者側を代表して、開会式を司会したスウェーデン王立理工学アカデミー総裁のG.ハンベリュース教授の要請により、後援団体の本田財団の創設者、本田宗一郎氏が、国王陛下の御前にて謝辞を述べ、これまでの3回にわたるシンポジウムの成果を踏えて、ここにディスカバリーズ活動の輝かしい第一歩を踏み出すべく努力することを強調され、各参加者の拍手を浴びた。

ストックホルムのシンポジウムを構成するにあたり、これまでの東京、ローマ、パリのしめくくりとしての意味をもたせた。つまり、東京で総合的な舞台づくりを行い、ローマはこれを国際社会で試演することであった。その結果、コミュニケーションと情報の課題の重要性が認識され、ストックホルムでは、今後の具体的なディスカバリーズ活動の展望を考慮しつつ"人間と社会—情報技術の役割り"を、まえにあげるようなスケジュールで論じたのであった。以下にその概要を筆者の考えをまじえて要約する。

2．コンピューターと社会制度

国際情報処理連盟（IFIP）の会長などを歴任したオーストリアのH.ゼマネック教授は、グスタフ国王陛下の開会宣言に引きつづき、会議全体のキーノート・スピーチとしてコンピューターの活用と社会制度の相関を論じた。これらの事柄は21世紀に向けて、周到に分析研究することの必要性を指摘して注目をあびた。もともと技術進歩の目的は、多くの場合、人間の労働負担の軽減であり、したがってそれは、過渡的に雇用問題に大きな影響を及ぼすことになる。こうした社会問題への波及効果があまりにも早急に人間社会に現われ、技術を超えた分野に転移し、いくつかの職種に大きな問題を引きおこしている。

ことに、コンピューターを中軸とした情報システム技術は、いたるところに、人間性疎外の原因をつくり出してきたことを、注意深く認識する必要がある。具体的には、中央にコンピューターをもつ多くのターミナルで作業する人々にとって、そこに目に見えない管理体制が作用する。つまり、見かけ上は自由に仕事をしているようにみえるが、実はターミナルからの出力によってのみ、すべての作業者が集中管理されているという、いわゆる管理上の集中された分散に、作業者がどう反応するか、ということは社会的にみて大きな課題である。これらの問題については、ディスカバリーズのパリ会議でもいくつかの具体論が提示された。

コンピューターによる集中管理は、このところコンピューター言語構造の進歩によって、多少なりとも良い方向に移りつつある。しかし人間の用いる自然言語とコンピューターの言語は明らかに異なっているし、直接的に人間の音声でコンピューターを駆動することも、ごく限られた実験を除いては困難である。これらの解決には、人工知能（Artificial Intelligence）とよばれる分野の研究成果に待つところが大であるが、近い将来に人間とコンピューターが、

あたかも人間同志が会話をするように、スムーズにコミュニケートすることは不可能だろう。コンピューターについては、その一分野での思わぬ成功から過大評価された観もあるが、コンピューターがいかにすぐれたとはいえ、現在の機能では、入力データをより正確で信頼性のあるデータに変えたり、それをもとによりよい情報をつくりあげることは、不可能なのである。言いかえると、ガサネタをいかにコンピューターに入力し、これをもとに高級な演算で加工をくり返しても、所詮いいかげんな情報しか得ることができないのである。

フランスの哲学者デカルトは、人間の脳とその機能を、当時の最も精巧な機械である時計になぞらえ、その論理性を論じたが、この論理の延長上で、脳とコンピューターの相関を論じることは、現代文明に於てすら全くナンセンスと言わざるを得ない。人工知能研究者の一部が、人間の知能を超えるスーパー・インテリジェンスの実現を主張し、その研究にとり組んでいるが、それは人間知能のほんの一端、たとえば正確で莫大な記憶能力とか計算速度の向上などを極端に巨大化したものであるに過ぎないのである。

情報化社会になるほど、人間はただ単に自らの活動の効率性をのみ追求するのではなく、人間としての友情や感性を求めてくることは事実である。コンピューターに導入するデータは物理科学的な数値によるデータであり、この一部あるいは全体に人間の感情なり感性が作用して“情報”となるのである。したがって、情報は人間が作り出すものであり、コンピューターが出力として作るものではない。コンピューターは、人間の感覚に訴えやすい型で、データを処理し出力の型をつくりあげる必要がある。

コンピューターが社会のなかに普及するにつれて、それは行政のなかにも導入されつつある。しかし、重要なことは、コンピューターにより行政に関する情報が大衆に伝達された後に、大衆の反応をどのように速やかに行政側にフィードバックするかということである。コンピューターを政治制度に導入することも一部の社会科学者のなかで論じられているが、重要なことは、その出発にあたって、人間による政治とコンピューターの仕組、いいかえるとフィロソフィーの相異を認めることである。このことは社会や文化にかかわる課題であり、機械の側から政治制度に物理科学的にアプローチすること自体、大きな誤りであると言わざるを得ない。

とくに、欧米の政治体制とわが国のそれを考えると、民主主義の土壌も大きく異なり、政治感覚も異質であることから、一部の国家における社会的成果をもとに、その可能性を論じるべきではないだろう。

コンピューター化された政治体制を実現することの困難さは、多くの人々にとっては衆知の事実である。にも拘らず、コンピューターの普及は、われわれにその神話的有効性を押しつけてくる。このことは、情報化社会が進めば進むほど、強力なものとなり、人間社会の一部では、医療情報システムによる健康管理のように、コンピューターは明らかにその威力を発揮するだろうが、それによる威力が増大されるほど、社会のどこかに大きなしわよせが生じることも事実だろう。コンピューターの有効性が強力なものになるほど、人間社会の運命はつねに情報化社会を展開する人々の手中にあることを忘れてはならない。人類の特質である人間性にもとづく芸術や信仰などは、その意味でわれわれ自身が守るべきものなのである。

コンピューターを中核とした情報化社会の理想的なシステムは、国際社会における理想的民主主義がそうであるように、現実社会において実現することはほど遠いようである。

3．技術進歩とその効果

コンピューターによる機械化システムが、社会にどこまで受け入れられるかを考えるとき、その背景として社会性や文化性とともに、機械がどこまで人間に近づくことができるかを論じる必要がある。ことに、情報化社会での機械システムは、さきに述べた人工知能の研究成果に待つものが大きい。それは、超機械化を可能にすることで、超知能（スーパー・インテリジェンス）も含めて、機械システムの側からその可能性をさぐってみよう。

コンピューターとコミュニケーションの結合は、いまや世界的規模で、超人間的な能力を実現していることは事実である。しかし、それが超人間的な人工知能を生むことに、結びつくとは考えられないが、専門家の中にはその可能性を信じ、今のうちにその成長を制御する国際機関をスイスに作るべきであるとの提案がなされ、ＳＦの世界をみる思いにかりたてられた。ともかく、問題はコンピューターによる超知能の出現を確信している科学者がわれわれの身近にも多く、しかも彼等の手によって現代の情報化社会が展開されている事実である。

超知能あるいは将来の人工知能の内容を定義することは、きわめて困難であるが、人間のもつ知能の不確実性の壁にぶつかるとき、コンピューターによる人工知能研究のジレンマ、もしくは将来に研究課題を残すということでその逃げ道をもつことは、科学者にとっても幸運といわざるを得ない。

機械システムが社会性をもつに至ったのは、いわゆるオートメーションにはじまる。アメリカのデトロイトに生まれた大規模な自動車産業におけるオートメーションの起源は、いわゆるトランスファー・マシンによる生産形態であった。そこでは、各種の工作機械が単体としてではなく、労働者や機械を介して情報で結ばれたひとつのシステムとして機能したのである。論理的には、N.ウィーナーが提唱したサイバネティックスの原理である。サイバネティックスについては今さらいうまでもないが、その基本はフィードバックにあり、生物が生まれながらにしてそなえている通信と制御のシステムである。機械的には、システムの出力側、つまり製品のつくり出される出口をつねに監視して、その情報を入力側、つまり材料や部品の供給部にもどして、全体のシステムを管理し、目的とする出力をつねに安定に確保することである。

したがって、情報の立場からみたオートメーションの原理は、産業生産部門のみではなく、農業、鉱業、輸送、通信、会計経理、銀行業務などの分野をはじめ、管理、行政、教育、医療という非産業システムの分野にも導入され、社会のなかで大きな役割を演じている。とくに、コンピューターの性能向上とともに、そのコストの低下は、社会のなかに複雑な影響を与えるほどに普及し、この分野でのテクノロジー・アセスメント（技術再評価）の必要性をも増大している。

いかなる分野のオートメーションにおいても、その特質がどれほど向上したとしても、それを管理・運用する人間の情報処理、あるいは管理能力の延長にそれらを位置づけるべきである。とりわけ、個人や社会の情報処理能力を把握することは重要なことで、それぞれの能力にマッチした適合情報システムを構築することの重要性がある。

情報処理の分野では、過去4半世紀にわたるコンピューターの驚異的な発達が、きわめて特殊な状態をつくりあげた。たとえば、産業や情報化社会の分野を考えるまでもなく、小型で高性能なマイクロ・コンピューターが普及し、それは子供達のおもちゃの分野にまで進出し、今後の日常生活を、さまざまな形で変化に導くに違いない。

こうしたエレクトロニクスの小型化の進展は、各種の超小型コンピューターや、高性能コンピューターの出現を可能にしてきたが、ハードウェアの発展とともに、ソフトウェアの研究は必ずしも満足な成果をあげていない。このことは、はじめに述べたコンピューター用言語の問題に帰するもので、コンピューターを活用する際にどうしてもさけられないプログラミングの作業は、依然として複雑で退屈な仕事であり、人間性を喪失するに充分な要素を含んでいる。この分野の開発がなされない限り、コンピューターはわれわれ人間にとって永遠に異質の機械なのである。しかし、この障害もある領域でのコンピューターの成果を考えるとき、ほんの一部に過ぎないといえるかも知れない。

たとえば、コンピューターは社会のなかで、ルーチン化された行政上の書式や文書などを処理するには、すぐれた能力をすでに有していることも事実である。現在、多くの国々で行なわれている官僚社会での文書の“たらい回し”に、もしコンピューターによる情報処理システムが導入されれば、ある国では恐らく現状の50%の労働力を削減することが可能となるだろう。その結果、一時的には雇用問題に発展するが、情報処理システムの導入によって削減された労働力は、社会のなかにさらに価値ある雇用を模索し、これをつくり出す要因となるだろう。

われわれの社会は、情報化技術が進むにつれて、潜在的な失業をつねに内在している。それは主として行政や管理業務を担当している非生産的な労働の分野に多く、いわゆる官僚社会における書類のたらいまわしなどは、そのさいたるものである。現在これら作業者に要する負担は、産業などの生産的労働により生み出されているのである。

21世紀に向けて、われわれは社会の変化を充分に予測し、社会における労働の規範を確立しておくことは、ますます進展するコンピューター化を考えると、きわめて重要なことである。自然のなかで神は人間を創造し、彼等の繁栄を助けてきたが、人間が創造した人工的な神々である機械たちは必ずしもわれわれ人類をエデンの園に導くとは限らないのである。そこまで、万物の創造主である本来の神が、慈悲深くおわすかどうかは今後の課題であろう。

人間による技術が、本来の神によってその安全性が保証されるためには、恐らく多くの神話的な手続

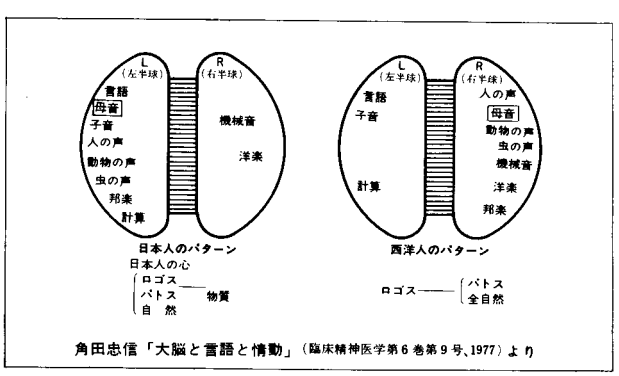
きを要するであろう。そのひとつの試みとして、テクノロジー・アセスメントが具体化され研究機関でさかんに導入されてきた。こうした研究をもとに、責任ある国際機関において、とくに原子力など新しい巨大技術についてのテクノロジー・アセスメントを実施することの可能性などを今後とも論じるべきだろう。しかし、これらの論議を論理的に容認し、実現に向って努力することには価値があるが、現実の課題として、それはきわめて困難な道であることは明白である。

4．情報化社会と個人

コンピューターを軸とした技術の進歩は、マス・コミュニケーションを可能にし、社会として人間集団としての便益を、ますます向上させつつある。そのなかで、個人の生活が受ける影響を考えることは、将来の社会を構築するとき、きわめて大きな意義がある。

とりわけ、情報化社会がつねにより高度な段階を指向しているとき、そこでの個人的役割、あるいは個人への影響を考慮することは、今後の技術の方向をも左右する基礎として大切なことである。つまり、社会に於いての家族構造を考えると、そこに個人の立場が強調され、家庭内は勿論のこと仕事場、職業訓練などにおける、情報化技術の影響を調査することは重要である。

情報化社会において、コンピューターなどの端末器などの機械は、人間の頭脳と手足に、ひとつの新しいインターフェイスをつくりあげ、われわれの労働環境にひとつの新しい外界を構成している。このことは、考えようによっては、人間の頭脳労働の補助装置であり、人間の知的作業の延長を、機能的に実現しているものである。基本的には人間のもつ脳の機能的支配の相異、つまり左半分は理性的かつ分析的機能であり、右半分が空間的かつ全体論的な機能をもつと考えると、外界につくりあげた情報化機器は、理想的には、それらの脳支配の差異を統一することを終極的な目標とすべきである。



角田忠信「大脳と言語と情動」（臨床精神医学第6巻第9号、1977）より

図－1　脳支配の差異

ところが現実の問題はどうだろうか……。人間的な思考のなかで、コンピューターは図にもあげたような脳支配の左右の差異を、調和する方向にはなく、むしろその不均衡をますます増大しているようである。われわれは、謙虚な心でこのことを認めることから出発する必要がある。情報化機器は、直接的に人間の肉体に属すものではないが、当事者は明らかに自らの延長物として、それを操作し運用することから、人間を孤立させ、精神的能力とくにその形而下能力をも低下させる可能性がある。

つぎに、考えられる不均衡の増大は、株式価格の表のような、数値的かつ理性的なアプローチを、情報化機器の普及は、社会のなかにますます強化することになる。こうした数値的な表現は人間にひとつの数値信仰を生み、芸術的かつ美的なアプローチをにぶらせるのではないかという懸念である。したがって、社会はこうした領域での個人的な能力の低下を、バックアップする総合的なシステムを構築しなければならない。このような配慮を社会が怠れば、個人は脳の左半分の機能を電子技術の支援で増大させ、ついには極端な精神的不均衡を生じ、社会的な動揺を招く危険性を内在している。

コンピューターの端末器が職場から家庭へともち込まれるにつれて、商業デザイン、建築、タイピングなどのサービス業に従事する人々の仕業上の能率を向上させている。また、科学研究についても同様で、家庭から自由に大型コンピューターを利用することで、その研究効率が倍増した事実もみられている。こうした便益とともに、機械の人間的接触によるさまざまな功罪を、個人と社会のレベルでわれわれは注意深く観察し、今後の情報化社会づくりのシナリオに役立てねばならない。

“われわれは多くの情報をもっている”という自信に満ちた言葉をよく耳にする。しかしそこにどれほど多くの、誤った情報があることを知っているのだろうか……。国際社会において起こる各種の事態は、多くの場合こうした誤った情報による判断に起因している。

一般的にみて、現代社会の人々は、多くの情報を求め右往左往している。しかし、肝心なことは、それが正しい価値ある情報であることである。さらに、数値的なデータを、価値ある情報に変換しえる正し

い精神の介在なのである。それなくしては、データや情報など一片の価値といおうか、すべてを誤らせる元凶となる。

そこで、“知らないでいる権利”について、われわれは真剣に考慮すべきである。とりわけ医療患者について、どれほどの情報提供が必要だろうか……。この知らないでいることの権利は、ある分野では社会における大きな権利であるが、いくつかの政治的あるいは社会的な分野では、かなりの非民主的思考を助けることにも、なりかねない。

研究教育の面において、コンピューターはその大きな道具となりつつある。つまり、研究においてはシミュレーション技術を可能にし、教育面ではCAI（Computer Aided Instruction）などを生みだし活用されている。

ことにシミュレーション技術は、実験をともなう研究の補助手段として、その効率を向上し、工業的分野はもとより、経済などの未来予測の分野にその威力を発揮している。これらの情報処理システムは、個人の研究における発想の分野に貢献するのではなく、あくまでもデータのくり返しによる実験に役立つものである。したがって、帰納的方法よりも、演繹的方法（脳の左半分の機能拡張）について適用されるもので、人間の直観性がそのため疎外されることにもなりかねない。

5．社会現象への対応

情報化技術、ことにコンピューターとコミュニケーションによる技術の進歩は、国際社会に大きな影響をおよぼしている。とくに、東西両陣営の緊張緩和（デタント）にとって、情報化技術の果した役割を見逃すことはできない。

しかし、一方では情報化技術は官僚社会での産物であり、そのため官僚機構の改善に役立つであろうが、官僚機構の目標をも変えることは不可能であろう。いずれにしても、コンピューターの普及は、その情報処理能力のめざましいスピード・アップのたまもので、そのため数値的データの交換に関しては、国家的および国際的競争において、他に遅れをとることを避けることが可能となった。

こうした観点から、人間社会のなかで果しているコンピューターを軸とした工学技術を分類すると、コマンド（指令）、コントロール（制御）、コミュニケーション（通信）の技術進歩とそれらのシステム化などがあげられ、それを踏えたインテリジェンス（データや情報の収集とその判断をもとにした指揮と制御の機構）がクローズ・アップされてくる。

最近のわが国における選挙にみるまでもなく、民主主義社会ではさまざまな世論調査がみられる。その手段としてコミュニケーション技術を導入した“押ボタン式”世論調査のシステムなどが論じられている。これはいわゆる民主主義的な決断のひとつのシステムと考えられるが、そのためには、押ボタンを用いる投票者に、その決断にあたって必要かつ十分な情報が、同じ押ボタン式コミュニケーションの手段によって提供される必要があろう。政治とコンピューターについては、さきにも述べたが、もともとそれらの相異点について十分に認識する必要がある。つまり政治のプロセスは、必ずしも合理的、効率的なものではなく、経験と因習、利害と打算などが複雑にからみ合っている。ホンネとタテマエというのがもっとも複雑にからみ合う分野である。これに対して、コンピューターは、きわめて合理的な論理で動作し、不確実なデータや情報は受けつけないし、それを処理する能力もない。したがって、コンピューターが政治のなかで果し得る役割は、投票数などの、きわめて効率的なカウンターなどの役割を果すにすぎないのである。

コンピューターで各種のデータ・ベースをつくるとき、そこにプライバシーの問題が生じる。これは誰しも懸念することであるが、記号や暗号の技術進歩によって、データの“一方通行”を可能にし、将来この問題はほぼ解決されることになろう。いずれにしても、プライバシーの問題は、情報処理システムのなかで、機械側にあるのではなく、機械を管理している人間の意志によるものである。

国家機構の行政能力の効率向上を計る意味での情報処理システムの必要性を否定することはできないが、そこに官僚的な秘密や意識的な操作がみられるとき、民主主義的な信頼感を失わせるひとりの破壊者像を描き出すことになる。つまり、コンピューターによる情報処理システムは、国家的な全機能の一部を代行するものであり、その活用はそれが労働組合や資本家を問わず、新しいパワーをもつことになる。そこで新しい勢力への対応を考慮する必要があり、これは18世紀にモンテスキュー（フランスの政治哲学者）により定義された、政治における対抗組織のコンピューター化された形態であるといえる。

いずれにしても、社会での情報処理システムは、

それが人間活動の道具であることを第一条件としている。つまり、すべてが人間的な理解と行動の範囲内で管理・運用されるべきもので、人間がそれに僅かながらでも、知能的活動を依存すべきものではない。われわれがもし、そのことを怠れば、社会はコンピューター・システムの理論によって支配される集団となり、そのなかで官僚社会がどう機能するかは、権力の性格と構造を考えるとき明らかである。また、コンピューターによるデータ・ベースについては、その要員の確保と質の向上は重要な課題である。なぜなら彼等のストライキにより、すでに老令年金の支払いが阻害された事実もあるからである。このことは、さらに強力で完成した自動化情報処理システムの、研究開発の必要性を促進するものである。

情報化社会は、さきに述べたように各国の雇用状態を根本的に変革しつつあり、その傾向は今後ともますます増大するだろう。このことは、労働組合対資本家、あるいは管理側との早急で大規模な対立を招くまえに、未来社会に向けて、より適切な問題を提起し、これを解決する試みが必要である。その意味でつぎに述べる適合技術（Appropriate Technology）の課題は、社会においてこれらの雇用問題を調整するシステム技術としても重要なことである。

6．エコ・テクノロジーの提唱

技術的課題として、最近、注目をあびているものに、適合技術がある。去る6月、南イタリアで国際会議がIFAC（国際自動制御連盟）の主催により開かれ、南北両陣営の人々が集い盛況であった。そもそも、適合技術の目的は、南北の格差を技術移行により是正することであったが、それらが議論されるにつれて、文化や社会制度を重視した技術システムの創造の重要性が説かれ、先進国自身においても、問題にすべき課題が多く認識されてきた。

適合技術は、わかりやすく言うと、Aという文化圏で発達したA′という技術を、Bという文化圏のB′という技術とともに、その国のニーズB″をいかに満足させるか、ということからはじまる。言いかえると、A′の技術を導入してB″というニーズを満たすため、Bの文化圏に新しい技術A′B′をつくりあげることで、これを適合技術とよぶ。

したがって、適合技術は単に先進国が発展途上国に技術援助をするということではなく、対等の対話がその条件である。つまり、発展途上国の側に、シーズ（種）となる技術がなければ、いかにニーズのみ強くとも、適合技術を生む文化、もしくはソイル（土壌）がないとそれは不可能なのである。さらに、文化圏の相違による反発はきわめて根強く、言葉や文字ではとうてい解決されない、多くの要素をもっている。しかし、技術が文化のひとつの表現である限り、そこに適合技術のシーズとなる技術があれば、技術をもとに、共通の目的を達成しようとする人間のコミュニケーションが生まれ、適合技術の創造を可能にすることができよう。

技術が一人歩きするほどに巨大化し、強力なものになったとはいえ、それが真の威力を発揮するためには、つねに人間の協力を必要とするのである。国際技術交流のなかで、それが大きな成果をあげたものほど、異文化を背負った人間たちの闘争と協調の物語が秘められている。手づくりの共同作業による技術が、異文化を超えて、人々の心のなかに連帯感をつくるのである。

これまでのディイカバリーズ国際シンポジウムの成果をもとに総合的なエコロジーとテクノロジーの調和をめざした技術として、ストックホルムではエコ・テクノロジーを提唱したのである。

環境科学の総合的な研究としては、これまでも国際機関を中心に、エコ・サイエンス計画が決定され、生態学からの研究がなされてきた。エコ・テクノロジーは、この成果を基礎に、文化と技術の対話をもとに創造される技術システムである。具体的には、さきに述べた適合技術の概念を、エコロジーをもとに、より一般化させた技術展開のプロセスということになる。したがって、エコ・テクノロジーは国際間は勿論のこと、自国のなかでも適合技術の創造を可能にするシステム技術である。

とりわけ重要なことは、社会の目標とニーズを達成する技術が、何よりもその地域のエコロジーや社会性の枠組を逸脱するものであれば、それは不適合となり、技術の展開は中止すべきである。こうした管理機構をも統括しえるのが、エコ・テクノロジーである。

ところで、文化と技術の要因を考えると、文化は個人と社会より成り、さらに個人は教育、経験、イエ的慣習により左右され、社会は法律、社会的伝統、地理的条件などで成り立っている。こうした文化をもとに、技術を考えると、訓練、熟練、物質（ものの）、地理的条件、管理機構などの諸要因により展開される。

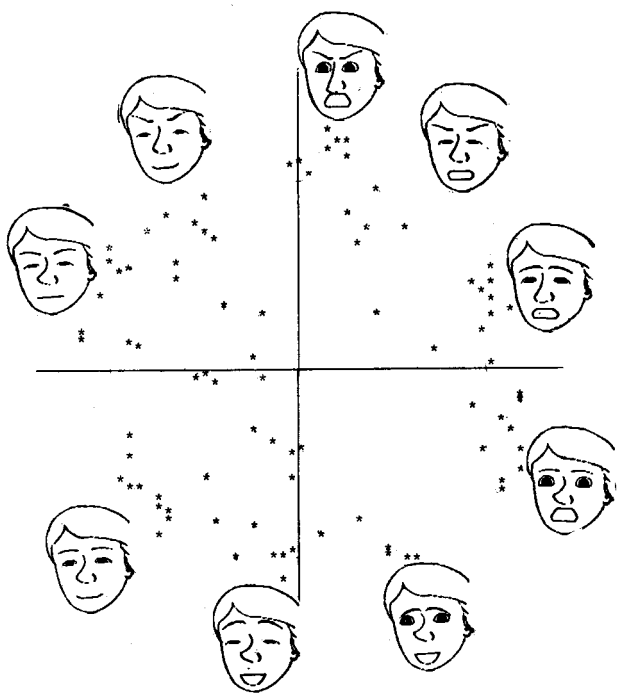
このような図式により、文化と技術の相互関係を考えると、文化の個人的諸要因には、技術の訓練と熟練が関与し、社会的要因には技術の物質と地理的条件がかかわり、それらの二つのグループをつなぐものとして、管理機構が位置づけられる。

勿論、文化と技術の対話は、こうした分析的な図式にそって進むものではないが、エコ・テクノロジーの概念を把握するため、ひとつのイメージを提供することができよう。

「文化と技術の対話」を旗じるしに、はじめられたディスカバリーズ国際シンポジウムも、ここに至ってひとつの具体的課題に到達した思いである。現在、西ヨーロッパでの失業者は 800万人ともいわれ、ＯＥＣＤ全体では、1,800万人にものぼると推定されている。この事実から、技術進歩が職を奪うものであるとの確信がみられるようになったのも意外なことではない。歴史的にも機械が失業の原因だと誤信し、機械破壊主義による暴徒をよんだラディズム（Luddism）を思い起こすとよい。人間は自らの歴史のなかで、たゆみなく生活状態の改善に力を注ぎ、その結果として一連の技術革新をもなしとげてきたのである。生活のなかで、仕事の軽減とその効率化は自らの目標であった。生産活動においても、人間の労働は富の平等化からそれを得るための効率化に向い、技術進歩に従って、いまや人間化が問われているのである。こうした、人間活動の新しい展開の時代にあって、われわれは心を新たにして技術立国の道を歩まねばならない。

いずれにしても、われわれが近代技術を必要とするのは、人間から職を奪うためではなく、人間を知的かつ創造的な行動にいざなうためである。したがって、技術にかかわるシステムで、何か大きな誤りがあれば、それは機械システムにその原因があるのではなく、それを造り採用した人間社会の側にあると考えるべきでだろう。人間の未来は、つねに自らの責任でつくられるのである。したがって、文明の将来に巨大危機（メガクライシス）をみたとき、われら自身で適切な危機回避の処理をとるべきである。

多くの諸技術も、より人間の側に立った研究開発が必要であり、コンピュターの出力として人間の大脳の右半分を刺激するような“あいまい”さをもったの研究成果について論議された。このことは、ディスカバリーズ活動が、その当初から指向してきたもので、その具体的な手法として、コンピューターに人間の顔の線画を出力として描かせ、それを人間が見ることで、顔の表情からそのシステムの現状を判断し、顔を描き出したもとのデータを分類して、多数の領域の相関を検討するものである。この手法を用いて、国際関係や経営管理などのデータをもとに人間の直感に訴えやすい顔をコンピューターでつくり、数値データのより“あいまい”な表現により、人間の知覚的判断を重視したシステム評価ができる。図２はその一例を示したものである。



図－２：７分野のデータによるコンピューター出力。顔の表情で国際関係や経営管理などシステムの動向を直感的につかむ。

21世紀に向けて、政策形成機能を情報処理技術で改善することは、大きな課題である。とくに、わが国のように地方自治体と中央官庁との、総合的な行政の調整をはじめ、その管理などの効率を改善することに、情報化技術は大きな役割を果たすことが期待される。こうした意味からも、それぞれの行政機構にとって、社会に適した適合情報システム（Appropriate Infomatics）についての論議が必要である。

７．ディスカバリーズ宣言

これまでのシンポジウムを、情報の観点から総括するのが、ストックホルム会議の目的であったが、その一端をかいまみる程度となった。

しかし、一応の結論としてつぎの３点があげられ

る。第一に技術は人間により、善にも悪にも活用される。そうした意味から人間の英知をもとに技術の成果を管理・運用せねばならない。第二に情報処理技術の進歩は、近世の産業革命に劣らぬ重要な歴史的意義がある。第三には情報化社会は、科学者から政治家まで、一貫した理解と責任の上に構築されねばならない。つまり科学技術の進歩と、それを社会に導入するという行政上の判断は、独立に調和をもってなされるべきである。それなくしては、健全な社会的繁栄をみることはないだろう。

以上のような見解をもとに、総合的なエコ・テクノロジーを設定し、つぎのような『ディスカバリーズ宣言』を採択して5日間にわたる会議を終了した。なお、閉会式はとくにスウェーデン国会議事堂を提供されたことを追記したい。

（注）本文に拙著「文化と技術の対話―ディスカバリーズ学事始」『諸君』(文芸春秋社)1979.12月号の一部を引用した。

ディスカバリーズ宣言

1979年8月17日
ストックホルム
（財）本田財団

人間尊重の文明を創造することは、今日、われわれ全人類にとっての大きな願望であります。それは、現代に生きる多くの知識人、とりわけ科学技術にたずさわる人々の相互協力によって、はじめて可能になり得るものであります。

本田財団によるディスカバリーズ国際シンポジウムは、こうした理念をもとに、東京にはじまり、文明のふる里ローマ、文化の都パリ、そして学術と科学の薫り高いストックホルムへと引きつがれてまいりました。

われわれは、これまでの国際シンポジウムにおいて、現代文明に内在するものと考えられるカタストロフィーについて討論し、人類が早晩直面するであろうメガクライシスへの認識を深め、これに対処するため〝インフォーメーション〟と〝コミュニケーション〟という、人間活動にとっての最も基本的な課題について、総合的な検討を行ってきたのであります。

われわれのディスカバリーズ活動の目標は、現代の技術文明が直面している真の問題を見極め、それらに取り組むための方法論を見出し、ついで、この任務を果すために人間の英知を結集する舞台をつくることであります。

このため我々は次の三つの活動をはじめることを宣言いたします。

1．エコ・テクノロジー確立のための国際的技術協力の推進

人間社会に真に役立つテクノロジーを確立することを目的としています。

エコ・テクノロジーの概念はエコロジーとテクノロジーの調和をはかるものであり、適合技術（アプロプリエート・テクノロジー）をも含むものであります。

2．本田賞の設定

エコ・テクノロジーの分野で顕著な業績をあげた方に贈呈いたします。

原則として年間一名、副賞として賞金1,000万円。

3．ディスカバリーズ国際シンポジウムの継続

エコ・テクノロジーの分野に関連し、今後も必要に応じ、国際シンポジウムを開催いたします。

COMPUTERS AND SOCIETY: INTERNATIONAL SYMPOSIUM ON AUTOMATED INFORMATION PROCESSING

"The Computer is here to stay, and it is going to help us all to achieve a better world." With this declaration of faith, His Majesty King Carl Gustav of Sweden opened the fourth international Symposium of the Honda Foundation's "Discoveries" Project, held at Saltsjöbaden, Stockholm, from 13 to 17 August 1979. Organised by the Royal Swedish Academy of Engineering Sciences (the IVA) the Symposium had the general title *Man and Society — Automated Information Processing*, a subject which took the basic "Discoveries" objective – the humane use of human ideas – deeply into one of the most controversial areas of modern technology. As the King also said in his address, all progress has two aspects, and we cannot enjoy the benefits of new tools and new techniques without also studying possible negative effects.

Automated information processing is in fact already widely used in many areas of human endeavour, not only in more or less "pure" science and technology but also in many day-to-day administrative functions notably in commerce, accountancy, and the bureaucracy of government and local administration. It is probably in this last field that it has so far created most public anxiety, based on fears that computerised filing of personal information about many, or even all, citizens is some form of affront to personal privacy. This public anxiety has led to demands in many countries that "computer bureaucracy" should be legally regulated and controlled . . . and it happens that in Sweden such legal controls have already been instituted.

But another fear, which may well prove more serious than that for individual privacy, is the fear that computers in office work and administration could lead to severe unemployment in these sectors.

Already many routine tasks in record keeping and correspondence are being taken over by automatic devices: already the effects can be seen in reduced conventional correspondence by post, greatly reduced manual record keeping, and a great increase in computers "talking" directly among themselves without human intervention – yielding the results of their conversations to their human paymasters through sophisticated "interface" equipment such as input/output terminals often at great distances from the computing centres.

These matters – and the important human and sociological questions they raise – were the subject of a keynote address in the Saltsjöbaden Symposium's opening session from Professor Heinz Zemanek, of the Technical University of Vienna. Before this address, however, and following the formal opening of the Symposium by H.M. the King, there were speeches of welcome and encouragement to the participants from Professor Gunnar Hambraeus, Managing Director of IVA and Chirman of the Symposium's Scientific Committee; from H.E. Masahisa Takigawa, Ambassdor of Japan in Sweden, who read a special message of support from his country's Prime Minister; from the Swedish Minister for Foreign Affairs Mr. Hans Blix; and finally from Dr. Soichiro Honda, founder of the Discoveries Project and of the Honda Foundation. Dr. Honda, who despite the fact that but for him the Symposium could not have taken place, insisted on being referred to as an "Observer", and repeated an earlier commitment to devote the rest of his life to furthering the Discoveries Idea and Project.

In his keynote address Professor Zemanek, a Past President of the International Federation of Information Processing (IFIP) reinforced the King's call for careful analysis of the sociological effects of automated information processing, and so reinforced the raison d'etre of the Symposium. The purpose of this advanced technology, he said, was work-load reduction, and this must of course affect employment.

The transitional problems might be hard – in particular if the transition took place so rapidly (as was in fact happening) that some professions and occupations became redundant within the lifespan of those concerned – but the eventual outlook could only be optimistic.

Nevertheless long-term and permanent social changes were to be expected, of which the "dehumanisation" of some existing personal relationships would certainly have a mixed welcome from the public. One most important effect would be the "centralised decentralisation" of much administrative work through the use of many

remote terminals connected with a central computer installation. (This effect had been referred to in earlier Discoveries meetings – in particular as eliminating the need for social concentration in towns and cities hitherto necessary for the transaction of much everyday business.*)

Professor Zemanek included in his talk some most valuable remarks on the structure and evolution of computer languages, and on developments towards what is today commonly referred to as Artificial Intelligence. It was perhaps a salutary experience to hear a renowned expert on computers insisting that although a computer might change, or destroy, information it could not generate *new* information with more "basic content" than that fed to it. For some who have – with Descartes – felt this to be axiomatic, the declaration surely made "AI" socially and morally, as well as technically and logically, acceptable.

One potential use of large computer systems referred to by the Professor was for feedback from the mass of the people following transmission to them of administrative and governmental information. Although a "Computerised political system" had not yet been attempted, he was convinced that it would be. "Our fate" he concluded "will remain in our hands, because computers will return decision-making to us ..... regenerating belief in humanities, in art and in religion". It would be interesting to see what comments this might stimulate in later sessions of the Symposium concerning concepts of "ideal democracy", in world communities which even if ideally informed could never be ideally (i.e. fully and equally) knowledgeable about technical matters.

Following Professor Zemanek (and an interval for a mid-afternoon Reception offered by the Honda Foundation before the departure of His Majesty) the Symposium then got down to the first stage of a practical "Case Study" of automated information processing – its application in medical care.

The subject was introduced by Professor Sixten Abrahamsson, of the Swedish Medical Research Council and Chairman of the Stockholm County Reference Group for the Development of Medical Information Systems. Referring to a recent world conference decision calling for "health for all by the year 2000", Professor Abrahamsson rather easily showed that this goal could hardly be achieved without a wide introduction of automatic processing of medical data. This is a matter which in the recent past has provoked considerable controversy among medical personnel and others, and it was encouraging to hear that a rather more positive ambience than hitherto was now developing. There are undoubtedly many applications in medical care – notably in individual record keeping and in rapid diagnosis – where computers offer obvious and important benefits. But it is still not easy to believe that the fully automatic doctor is just round the corner. (Later sessions of the Symposium were to show the very considerable advances made in this field by the Host country, Sweden.)

This fourth "Discoveries" Symposium was the latest in an ongoing series which began in Tokyo in October 1976, and had since continued in Rome (November 1977) and Paris (October 1978). The general objective of the series – originally conceived by Dr. Soichiro Honda at the creation of the Honda Foundation – is to bring together top world scientists and humanists from a wide range of disciplines to examine together present and future world problems, and to arrive at new approaches and ideas for their resolution. The Saltsjöbaden meeting was attended by some 50 such representatives from Europe, Japan, America, India and Africa.

* The sociological merits of such decentralisation do not, however, seem to be universally recognised: the human being can need fellow company for many reasons besides operational efficiency.

AUTOMATED INFORMATION PROCESSING SYMPOSIUM: DAY 2

If the first day of the "Discoveries" Stockholm Symposium was marked (in particular through the keynote address of Professor Heinz Zemanek) by restrained conservatism concerning possibilities for "Artificial Intelligence", the second day must be noted for the opposite emphasis. Several participants seemed ready to attribute supra-mechanical potentialities to what the session title described generally as "the machines", and in at least one case the claimed potentiality was for supra-human super-intelligence which, should it in fact be achieved in practice, would surely defy subsequent description as Artificial. It is probably unwise, in view of the realisation of so many concepts of one-time science fiction, to classify even the most imaginative claim as no more than that – and it is perhaps fortunate that the difficulties of defining super-intelligence (or for that matter "conventional AI") left escape routes for those unsure whether they were ensnared in a real or an artificial dilemma. However that may have been, the enthusiastic debate both within and beyond the session limits testified to the profound depths of thought engaged.

The session was chaired by Professor Erik Sandewall of Linköping University, and began innocently enough with a most helpful synthesis of the history, nature and impact of automation and automated information processing. Presented by Professor Reikichi Shirane, President of the Telecommunications Science Foundation in Tokyo, this set the scene by recalling the origins of large-scale automatic processing in the US car industry some half a century ago; the subsequent development of multiple servoloop systems (initially mainly for military purposes in World War II); and the post-war expansion of such concepts into cybernetic* automation or "cybernation".

Professor Shirane traced the effects of these various stages in man's increasing use of sophisticated control arrangements, not only in industrial production but also in fields such as agriculture and mining, transport and communications, accountancy, banking, and in "non-industrial social systems" such as management and administration, education and medical care.* The Professor pointed out how these applications had been made possible and worthwhile by developments in the technical performance of the computers used – notably increased operating speeds and computing capacities, increased memory capacities and reliabilities, and greatly reduced costs. However, he did not suggest that any of these attributes made the machine more than an important *extension* of the information processing capabilities of the men in control; and he concluded with some challenging remarks on machine/man relationships in Japan and the impact of the ever more ubiquitous computer on the Japanese social scene.

Professor Shirane was followed by Professor Sidney Michaelson (Edinburgh University) whose presentation of "The State of the Art in Information Processing" was a compendium of facts and figures illustrating the remarkable progress of computing machines over the past quarter century. To cite just one example of this progress, the Professor gave some details of a typical "quite large machine" of the early 1950s: 20 to 30 high-speed registers and a file store of a few thousand numbers. Today he said (or rather, in view of the speed of current development, yesterday) children could buy as *toys* devices of very small physical size which were a thousand times faster than that typical early machine, with a thousand times more immediate working storage and a thousand times the backing storage. Or again, about 400 dollars could now buy a machine bigger than what in 1958 was to do all the computing work of London University; while about 5000 dollars could buy a highly sophisticated machine for such complex work as modelling weather or queueing, or ("if we knew anything about it") society.

Very much more expensive and sophisticated machines do of course exist, and at this level very high speed machines capable of 200 to 400 million arithmetical operations per second on work for which they are suited (or mathematical work such as the solution of partial differential equations at slower but still very high speeds) can be bought in the USA for 10 to 15 million

*The American mathematician Norbert Wiener (1899 - 1969) who introduced the term cybernetics, insisted that he had only given an appropriate name to a long-existing characteristic of certain control systems – not only in machines but particularly in living beings.

*Automated information processing in relation to medical care was the subject of a "Case Study" continuing throughout the Symposium: see previous and later references.

dollars.

However, while the machines themselves have developed so rapidly, this is not true of programming, which although it has advanced in certain ways (eg. through the use of "high level programming languages") remains a complex, tedious and difficult matter with some programs requiring tens of man-years to develop.

Nevertheless there is no real impediment to the expansion of computer applications over a vast and increasing area, and Professor Michaelson was expressing the concern of many when he wondered what will happen as automatic information systems spread to that part of the work force (now estimated in some countries as up to 50%) which is employed in "shovelling around" papers, forms, and the correspondence of bureaucracy. Almost all routine office work could be mechanised, which could well lead to a 2/3 reduction in the number of people needed for this paper-shovelling, and such a reduction could probably be achieved – given sufficient effort and priority – in 3 to 4 years. Without special priority the change might take 20 years, and even on this time scale it would constitute an extremely severe social problem.

Subsequent discussion (notably contributions from Professor Harold A. Linstone of Portland State University Futures Research Institute, and Professor Ithiel de Sola Pool of MIT) led to some qualification of the figures above though not of the indicated trend. Professor Linstone also pointed out that, although some types of employment could be eliminated by widespread automatic information processing, other new and perhaps more rewarding employment was likely to be created.

It was left to Professor Samuel Finer (Oxford University) to put into somewhat forceful words a basic comment on employment which, surprisingly, rarely seems to be heard in discussions of this nature. Noting the post-World War II trend (still continuing) from productive labour in industry or agriculture to basically non-productive labour in bureaucracy, he reminded all present that the non-productive sector was nonetheless a consumer of goods and services, and must necessarily be "borne on the backs" of the producers of these goods and services. From the point of view of such production, paper-shovellers were no less unemployed than were those without jobs.

This concluded the morning's session, and gave participants ample material for discussion over luncheon. However it was the first paper of the afternoon, by Professor Edward Fredkin of MIT (former jet fighter pilot with a long and distinguished record in computing and the approach to Artificial Intelligence) to lead the thoughts of his colleagues to the highest flights of speculation about where the development of AI might lead us all, unless carefully and adequately controlled.

There is no questioning the seriousness of such speculation, nor the bulk of evidence at its base. Nor, surely, is it to be questioned that the limits to what Professor Fredkin suggested remain (for the present at least) limits of logical philosophy rather than of physical science*. Only thus could the session have found itself considering what (in the apt words of Professor Henri Tajfel of Bristol University) was a proposal that man would create – or perhaps re-create – God but then, because of uncertainty whether God would treat His human designer with due kindness and respect, would place Him under the control of an appropriate international institute until His benevolence could be guaranteed.

This in no way implies that the proposition was not to be taken seriously – as indeed it most clearly was by all present. However there were certainly some who found difficulty in accepting as logically possible that man, having succeeded in creating an "artificial" super-intelligence, which by definition had to be in part beyond man's comprehension, could then use his own inferior intelligence to ensure that his creation was "safe".

Similarly it seemed logically difficult to accept that, should the super-intelligence be created not within the control of a "responsible international body", but rather as a result of individual and possibly clandestine efforts by someone with less than world progress at heart, again the new super-

*It was in fact necessary to cross the latter frontier in order that the speculation could proceed.

intelligence could be manipulated by its less-understanding creator.

These questions and some others were formulated in a written "Discoveries Note" submitted by Professor Alwyn Scott (Wisconsin University), and echoed by several participants including Professor Eduardo Caianiello of Salerno University (member of the Symposium's Scientific Committee and a leading figure in the Discoveries Project from its earliest beginnings).

Professor Scott first raised the basic question of *definition* of "intelligence", for it seemed that to some this could mean no more than ability to draw conclusions (albeit much more rapidly and accurately than could a human brain) according to in-built or "in-fed" fixed rules of inference. Artificial Intelligence of this sort raised no problems, for basically it was no more than an *extension* of the intelligence of its creator, Man.

In contrast, many would define intelligent behaviour as behaviour requiring "an appropriate blend of thinking and *feeling*". Professor Scott, recognising here the danger of establishing one definition in terms of another non- or ill-defined parameter, suggested that a design requirement for a machine capable of such *feeling* should be "the development of a nonsymbolic (tacit) internal world picture against which plans and predictions are regularly tested". This led logically to a fundamental dilemma: it was very likely that the world picture of a machine would be different from that of a human being, hence a highly-developed AI machine would almost certainly be either unintelligent (in human terms) or alien.

In face of this somewhat disquieting conclusion, Professor Caianiello brought comfort by referring to the original optimism and subsequent – so far insuperable – difficulties over developing a language translation machine. Professor Fredkin had himself indicated that such a machine could not be expected until "true AI" (with at least the attribute of human understanding of languages) became available. Professor Caianiello believed that, beyond AI of levels equivalent to human intelligence, "super AI" could never be expected until machine translation had been achieved.

The work of this session was to have included comments from Professor Jean-Claude Simon (Pierre et Marie Curie University, Paris). Unfortunately Professor Simon was unable to be present due to last-minute illness. The session therefore continued with a further paper concerning the "Case Study" of automated information processing in the medical field. This paper, by Professor Kazuhiko Atsumi of the Tokyo University Institute of Medical Electronics, comprised a detailed description of how computer systems were being applied to represent health-care systems in several associated models: *Demand Model* (comprising 3 sub-models for population, morbidity, and demand-supply); *Resource Model;* and *Resource Allocation Model.* Professor Atsumi presented a wealth of information comparing the situations and problems of a number of countries. Although the "Case Study" had still to continue with two more papers, it was already clear that the computer could be of immense value in the assessment and forecasting of requirements for medical care, in the recording of data on patients and the establishment of statistics concerning illnesses, diagnoses and cures, and in various mainly administrative fields. It would seem, in fact, that the future citizen of the world will not be looked after from cradle to grave by a benevolent administration, but by a computer system . . . which by then, perhaps, will have become at least more intelligent than a government office.

AUTOMATED INFORMATION PROCESSING SYMPOSIUM: DAY 3

On its third day the Stockholm "Discoveries" Symposium turned its attention from "the machines" (or rather the machine-systems) of automated information processing, to the people – builders, users, beneficiaries and victims – and their interactions with the machine-systems now increasingly affecting so many aspects of their lives. It was probably not by chance that the day's session was sub-titled *The Individual* rather than people as a plurality, for one of the more evident conclusions was that the computer and its satellites could well lead to the substitution of individuals plus electronic equipment for physically-assembled groups whether at workplaces, leisure and amusement centres, commercial centres or assemblies for social, political or other purposes.

The fact that this phenomenon is not yet very widespread – and appears for the present to be limited to what might still be called the "higher echelons" of society (from which the Symposium participants could hardly disclaim their connections) makes it at once a subject where adequate data are rare; but where for most of the participants this rarity was compensated by close personal involvement. Thus it became clear that most participants had personal experience of computer-system terminals (though in some cases only through airline reservation or similar services), while quite a number had terminals installed in their homes . . . which had incidentally given them the chance to observe their families' reactions to the devices.

The proclaimed objective of the first (morning) part of the session* was to examine the effects of automated information processing on family structure, the household, place of work and vocational training. The examination was opened by Professor Harold Linstone (Portland State University Futures Research Institute) with a paper that implicitly recognised the equipment of automated information as an extension (or prosthesis) of the human brain to which it was attached. In other words the equipment displaced at least part of the interface between the brain and the "outside world", so that the brain had a concept of reality which must to some extent be artificial and unreal.*

Professor Linstone posed a simple but profound question: did this prosthesis of the brain through apparatus with particular characteristics apply equally to all brain functions or did it – as seemed more probable – extend mainly the rational, analytic functions associated with the left-hand half of the brain, the left neocortex? If this were the case, then the prosthesis must introduce an imbalance between the two main brain functions: rational and analytic in the left half, "spatial" and holistic in the right half. Such an imbalance must be expected to distort (even more than normally) the overall picture of the outside world, transforming it (in the Professor's words) "into a rational one-dimensional analytic world far removed from the three-dimensional, only partly rational one" appreciated by the brain as a whole.

Professor Linstone, who had earlier insisted on the speculative and empirical nature of discussions in this field ("It behoves us", he said "to approach any (such) discussion . . . with considerable humility"), speculated on the consequences of computer-created imbalance in the human concept of the world. The first, which he termed isolation, was in fact only isolation in the sense that direct human contacts could be lost, giving way however to much wider contacts – virtually instantaneous at the touch of a button – via the electronic extensions the individual concerned had attached to himself. It was certainly not hard to believe that this, for all its apparent advantages, could also lead to a reduction of the mental – and particularly the physical – capacities of the person.

A second, rather easily conceivable, effect of imbalance was of course a change in the individual's "relative appreciation" of artistic approaches to his brain (music, painting, poetry) compared with purely rational, analytic approaches (eg: tables of prices of stocks and shares). But a third effect, potentially more serious and severe, might be the effect of the individual becoming at some stage separated from the electronic "technological support system" attached to his left neocortex. This might well lead to excessive mental perturbation and breakdown.

*The session was chaired by Professor Torgny Segerstedt of Uppsala University

*Words used in a qualitative, descriptive sense. Their precise definition in the present context could well form the subject of a further symposium.

Opening the subsequent discussion Professor Murray Eden (National Institutes of Health, Bethesda, USA) confessed to sharing the ideas, predictions and fears of Professor Linstone. But he also noted that computer-system information terminals in homes frequently increased their users' enthusiasm for their work. As an example, making available terminals on loan to members of his laboratory staff had resulted in work being continued long after "normal hours" (in one case until after 3 a.m.): Professor Eden foresaw the development of a new series of "cottage industries" where workers operated almost entirely from their homes – in fields such as commercial artistry, dress-designing, architecture . . . and services such as stenography and typing.

Perhaps, he concluded, we were over-fearful of computer systems. Nevertheless there were obvious dangers, and he recognised that "interference with human inter-contacts" might have unpredictable effects.

The next speaker was Professor Kristen Nygaard, of Oslo University and the Norwegian Computing Centre in Oslo. The Professor introduced what is undoubtedly one of the most "delicate" aspects of the growing use of computer-based systems, whether in information processing or in many other activities, namely Trades Union reactions which are crucial for the general acceptance of these systems.

Such reactions have now been reported on and analysed in many countries, and although there have been cases of more or less stolid opposition, in general the attitude of workers* has been a positive wish to take part in, and enjoy the fruits of, exploiting the new technologies to the full. But as Professor Nygaard stated, "worker participation" needs to be very full and comprehensive if problems are to be avoided . . . or if not avoided, at least resolved. This is one of the reasons why Unions have established their own expert groups and committees to study automation and "Informatics" to the fullest technological depths, for clearly without such background, cohesive and collaborative endeavour to ensure benefit and avoid harm must be impossible.

Professor Nygaard gave details of some of the regulations in his country concerning the participation of employees' representatives in planning for the introduction of new technologies: it was to be noted that these regulations referred more than once to the representatives being provided with "all necessary information" to enable them to reach correct decisions.* It was perhaps to be expected that, looking back into history, the question should be posed whether, had such full information been made available about mechanised weaving technology to the workers about to lose their livelihood, this would have eased the introduction of the new technology. This prompted Dr. Fred Margulies, of the Vienna University of Technology, who has a long and influential association with the Trades Union movement, to comment that he did not like the enjoyment of a democratic right being questioned because of the possible use which could (or could have been) made of it.**

Professor Nygaard's commentary was followed by Professor Yoichiro Murakami of Tokyo University, who wished to insist that, in a world where very many were demanding access to more and more information, there could be those who preferred to be excluded from at least some of this. One of his examples (which incidentally had already been discussed at the 1977 Discoveries meeting in Rome) concerned the furnishing of information to a medical patient about a fatal disease he had contracted. "The Right to Ignorance", as the Professor described it, appeared clearly to be a democratic right: yet in some (non-medical) fields it could be conceived as non-democratic, since if exercised on a wide enough scale it could lead to distortions in popular consultation.

The afternoon part of this session began with a discussion of the effects of automated information

*The word is still widely used among those dealing in Union matters, though the implication that others in industry and commerce – such as managers – do not work is nowadays widely disregarded.

* Expressions such as this are quite frequently found in the literature (including legal literature) of "participation", doubtless providing much satisfaction for their authors, much heart-searching for those called upon to decide what may comprise "all necessary information", and much mental exercise for those (hopefully few) with something they may wish to hide.

**Nevertheless it is difficult to ignore the use – by at least two major dictators in the past half century – of guaranteed democratic processes and rights to achieve totalitarian power.

processing on education, both of young people and during later life (adult education).

Introductory papers were presented by Professor Henri Tajfel (Bristol University), Professor Zvonimir Damjanović (Belgrade University) and Professor Richard Ichiro Emori (Seikei University, Tokyo).

To some extent this session must have been a salutary reminder, to the computer and information experts, of the dangers of over-confidence that their advanced technologies must automatically revolutionise the world. For although there was no denying that the new devices could have substantial influence in some sectors, one had a feeling that the bulk of education would remain "conventional" for a very long time yet.

Indeed, there was rather little evidence of any immediate impact on normal schooling, and as for adult education the main concern seemed to be with consequences (in terms of unemployment) of expanding "computerisation", rather that what computerisation might do towards re-training the unemployed. There were many comments (eg. from Professor Tajfel) on the demoralising effects of long-term unemployment, and he recalled assurances, on the opening day of the Symposium, that the new machine-systems would create some new jobs as well as eliminating existing ones. But the Professor felt it quite possible that a significant proportion of the new unemployed would "lose their social definition and, with it, much of the willingness to take advantage of whatever may be available".

Professor Damjanović saw a growing influence of computers in *experimental research*, not as a basic educational tool but rather as, on the one hand, an aid to the experimental work itself (a "peripheral prosthesis" of monitoring and control) or on the other hand as a mental prosthesis of the experimenter. Professor Emori believed that information processing systems were – at least for the present – more applicable to deductive processes than to inductive processes (left neocortex versus right?) and stressed that greater emphasis on deduction could be damaging to intuition.

In subsequent discussion Professor Harold Lawson (Linköping University) returned to the Norwegian requirement, cited already by Professor Nygaard, that all necessary information about the introduction of new technologies should be provided for study by Unions concerned. He pointed out that the legislation now in force on this matter required also that the information be *in terms the employees' representatives can understand.* He saw here an important challenge to the "computer architect" and hoped soon to see the creation of "computer systems, documentation and development and educational tools that are easy for both experts and laymen to understand". A challenge indeed!

Professor Eduardo Caianiello (Salerno University) had some typically philosophical reflections with which to bring all around him back, if not completely to earth, at least to reflecting carefully on the real importance of automatic information processing in a very diverse world. He felt sure that, at the invention of the alphabet, there had been opponents who had called for its control or even suppression because, quite obviously, it was going to have great influence on future human thought and communication. The same could be said of the decimal system . . . and present-day criticisms of computer systems would, he believed, be forgotten in due course as had been those he had mentioned.

As to fears of unemployment, the Professor was the first (in this meeting) to openly equate some employment with a social service . . . necessary to occupy people who would otherwise have difficulty in occupying themselves. There had already been cases where less employees on a given task had resulted in greater efficiency, and it seemed that sometimes what was required in reality was not a job, but a pension.

The afternoon ended with a continuation of the "Case Study" of automated information processing in the medical field. This time it was Dr. Hans Peterson, Manager of the Medical Information System of the Stockholm County Council Public Health Board, who guided the session through an illustrated tour of his Board's extremely advanced system of individual record keeping, protection against non-compatible treatments, retrieval of all

relevant patient history at any hospital or treatment centre, and the use of the stored information where required for statistical analyses and *predictions* of future demands in various treatment sectors.

The system, which has some 400 data terminals, caters for the 1 1/2 million population of the Stockholm County. Over 80 hospitals are concerned; there are 25000 employees including 4100 nurses and 1450 doctors; and records kept for every patient include dates of any treatment, nature of treatment, medicines used etc., together with follow-up even if in a different hospital.

The system had many similarities with that reported previously from Japan by Professor Atsumi. In some comments, Professor Atsumi spoke of the costs of setting up such a system, and remarked that this factor could impede progress in some of the heavily-populated developing countries, where the need for improved medical care was greatest.

In a final general discussion on the whole day's session, it was clear that all present had been deeply impressed by the positive value to be drawn from these multidisciplinary approaches to a very esoteric subject. Although there was evidence of important disagreements in some matters, there was no doubt there had been learning (if only of a conventional nature) by everyone.

The "considerable humility" called for by Professor Linstone had been achieved.

AUTOMATED INFORMATION PROCESSING: DAY 4

The fourth and last full "study day" of the Stockholm Symposium was a very full day indeed. It was chaired by Professor Gunnar Heckscher of Stockholm University.

Having already examined (the previous day) the effects of AIP on the individual, consideration now turned to "society", that highly complex conglomerate embracing far more than a simple plurality of individuals (see Report on Day 3) by including also group life-support systems concerned with food, shelter and energy, and designed both to preserve the stability of the community and to ensure for all a "reasonable fulfilment" of their lives.*

Evidently in these considerations, the work of the previous sessions was to be taken into account, and the opening paper by Professor Klaus Lenk (University of Oldenburg, Germany) began by precisely formulating what had already been suggested by several discussion speakers: namely that AIP could be regarded from two quite different viewpoints. In the one it was a tool, in the hands of man, who could use it either for good or for evil. In the other it was an (at least partly) autonomous force created by man but capable of escaping from his control and thereby causing him unexpected harm.** Professor Lenk believed that both views were to some extent correct, and probably most of those present agreed with this: however the bulk of the discussion throughout the day was based more on the first hypothesis than on the second, and Professor Lenk believed this represented the feelings of the majority of social scientists as well as computer scientists. It meant, he said, that the impact of information technology upon society is "the outcome of the action of social forces, their aims, conflicts and philosophies" .... and this is certainly convenient since its understanding calls for no new revolutionary frames of reference.

AIP must thus be considered mainly as an aid to bureaucracy – likely to change existing bureaucratic structures but not their objectives. Because AIP could bring great improvements to the operation of bureaucracy, thereby giving it greater power over the community as a whole, it was frequently attacked by those outside the "office elite". But also, because it could enable this elitism to be maintained with far fewer personnel, it was equally under attack from within. Why therefore was its use continuing and expanding?

The simple answer appeared to be that in no other way could an increasingly complex and interdependent series of administrative systems (state grants and allowances, education, ownership and use of personal transport, medical care and social security, finance, banking, insurance, taxation, and many more) be operated at all. The human brain is not an efficient processor of vast amounts of alpha-numeric data, and when overloaded with such data not only deals with them slowly but also makes mistakes. The computer's performance in both respects is far superior.

A second reason for expanding use of AIP must certainly be to avoid "being left behind", in national and international competition where efficiency and speed bring success, while their absence brings failure and bankruptcy. Only a world-wide ban on AIP would make its abandonment possible without more or less disastrous consequences. Furthermore, universal deliberate blockage of technical advance can never be guaranteed, and those who might be first to break an embargo would probably be those with the least social conscience.

Yet the automation of bureaucracy brings its own constrictions and dangers. Complex AIP systems, once established and working, tend to be inflexible (except where far-sighted initial provision for later change has been incorporated). Especially in public and quasi-public services, inflexibility of the system will lead to inflexibility of the governing rules and regulations, making reform – even when widely agreed as disirable – practically difficult to achieve.* Another danger

* No one present disputed (possibly because the question was not raised) that without such "fulfilment" the human spirit could lose its motive force . . . and might conceivably die gradually away.

** Advanced technologies have of course long been used by man as tools (first definition) to cause expected and planned harm to other men.

* In AIP itself, the fact that one international manufacturing group dominates the market for equipment means that equipment made by other manufacturers must be "compatible" with established standards, if its use is not to present "unnecessary" problems.

lies in the opportunity and temptation for the remaining human staff in an automated bureaucracy to shelter from public criticism on the grounds that "the machine knows best" and that their decisions are no longer their own responsibility. Some may indeed believe, as Professor Lenk said, that AIP, besides shielding them from the turbulences of their environment, will eventually lead to a perfect administration (however that might be defined!).

Professor Lenk had some particularly interesting remarks on AIP and politics, notably on the concept of "instant consultation" of all people on virtually any matter through electronic voting from home computer terminals. This subject had been touched on by Professor Zemanek in his keynote address at the opening of the Symposium, but Professor Lenk seemed less sure of the advantages of instant referenda. They could, he said, lead to political apathy, if everyone had to fear that his political opinions were automatically registered and stored in some central data bank. Also, because of the ease with which immediate reactions could be obtained through electronic polling, there would be a tendency for preliminary discussion to disappear: hence there could be no guarantee that those consulted through such a poll were reasonably correctly informed about the question involved.* Nevertheless, concluded the Professor, "whereas the benefits of increasing information handling capacities to the representational process remain doubtful, experiments with the 'Electronic Town Hall' or 'Computer Democracy' could yield valuable results in some respects, if the temptation is resisted to distill alternative models of the political process from the limited experience they convey."

Discussion following Professor Lenk's paper was opened by Professor Ithiel de Sola Pool (MIT) who also had comments on "push-button" opinion polling, believing that this could and would be used as part of an interative process towards democratic decision-making, the same AIP terminals providing the voters with "the various kinds of data bases and communication facilities they would need for their different roles in the process". Certainly such procedures would seem more likely to yield socially sound results, in particular since one could easily include safeguards (such as preliminary "qualifying questions") before the push-button opinion was taken. Nevertheless the interactive effects of such preliminary questions, of the degree of "absorption" and comprehension by the voter of the "various kinds of data . . . etc.", and of the voter's initial intuitions and prejudices, might well make push-button consultation basically no more effective – though certainly more speedy – than present systems of interviewing and questionnaire-answering. As Professor Samuel Finer (Oxford University) subsequently remarked, "all the computer can do, in its push-button role for opinion sounding, is provide a very good counter of votes".

Returning to Professor de Sola Pool, he did not agree that computer-collected data and computer modelling would necessarily reinforce the power of those already in power. Although this might be so initially, when most of the AIP was in the hands of the controlling bureaucracies, the coming availability of cheap, large-capacity AIP equipment for virtually anyone who cared to acquire it must mean that opponents of established systems were equally able to use data and models. Thus "neither side" would have more advantage over the other than at present (indeed, the advantage might be reduced).

Finally, concerning privacy, and the widespread fear that AIP data files must lead to its more or less complete abolition, Professor de Sola Pool insisted that "one-way" codes and other forms of advanced encryption were available now, and in future would become "trivially cheap". The unauthorised retrieval of information could thus be made impossible, and rather than a general loss of privacy the Professor foresaw "a threat to publicness" and "some erosion of the common stock of knowledge shared by all".

It was in fact very clear that privacy or otherwise did not depend on the machines of AIP, but on the will of the human beings in control. Re-

* This would apply to virtually all questions. The additional difficulties of informing all voters about advanced technology (such as AIP – on some aspects of which, as the Symposium showed, even experts can have divergent opinions) appear insuperable. At least in these matters, and possibly in simpler ones also, the idea that the majority view must necessarily be correct is highly debatable.

assurances about the former had small relevance to the latter.

Many of Professor de Sola Pool's points were reinforced – not so much technically as philosophically – by Counsellor Thierry de Beaucé, former French Cultural Counsellor in Tokyo and now Political Counsellor in Morocco. Reminding the meeting that none present seemed to deny AIP's power to increase the efficiency of State administration, M. de Beaucé saw it also as the destroyer of *bureaucratic* secrecy . . . the baffling obscurity which thrives (and is sometimes cultivated) in hierarchical administration and which, despite claims to the contrary by those "in the business", constitutes a threat rather than an aid to the democratic process. Computers and AIP could, in fact, bring new power to the *challengers* of state omniscience . . . whether Trades Unions, social or commercial associations, manufacturing or trading companies, or many others. There would be a new balance of power . . . "a computerised version of the counter-organisations defined by Montesquieu in the 18th century."

But there were dangers. M. de Beaucé pursued a line of thought stimulated by both Professor Lenk and Professor de Sola Pool; namely that AIP, relieving man of much mental labour both in the acquisition and the treatment of information, and at the same time taking over from him much of the practical worry of keeping himself alive, healthy and supplied with the necessities of existence, could also induce growing intellectual scelerosis. This was the same point as made the previous day by Professor Harold Linstone, when he predicted difficulties for an individual who had come to rely more or less fully on AIP as an extension of his brain function, should that extension be cut off.

Pleading therefore for the maintenance of a full and lively *purely human* understanding of the world and its problems, using AIP strictly as a tool and not at all as a form of Artificial Intelligence, M. de Beaucé concluded: "If we neglect using our own intelligence, then we shall be dominated by the integrated logic of the computer system. Bureaucracies function that way, with an absurd logic which at the end hides reality."

Professor Samuel Finer agreed rather strongly with this, but saw a further and perhaps more serious danger in entrusting the control and use of vast amounts of data to a computer system. At least at present, the functioning of such AIP depended on a relatively small group (in some cases very small indeed) of operators and maintenance staff for the machines concerned. Such groups could use their position to deny the services of their system to its "clients".* And this was a minimal danger compared with the possibility that AIP programs might be clandestinely modified or distorted by highly competent renegade personnel, with disruption or subversion at heart. For example what might have happened, asked Professor Finer, if another threat by computer operators – to stop the automatic computation and allocation of Old Age Pensions – had been carried out?

This prompted an instructive rejoinder from Professor Lenk. In Germany, he said, already the payment of Old Age Pensions had been interrupted by a strike of computer operators. The occurrence had provided a powerful incentive to expand AIP even further, in an endeavour to eliminate completely all human operators.

The morning's session led to some lively discussion over luncheon of the rights or duties (according to viewpoint) of "labour" in face of a situation which was (according to viewpoint) to be welcomed or deplored. So lively that Dr. Fred Margûlies (Vienna University of Technology) felt constrained, when the session resumed in the afternoon, to remind all present that the objective of the Symposium was to seek solutions to problems, not to exacerbate them. "We all agree (I hope)" said Dr. Margulies, "that the employment situation today is basically different from that of a decade or so ago. We also all agree that predictions – whether about AIP use or the resulting employment situation – are problematic."

"Let us not, therefore, allow our discussions to become a Trades Union/non-Trades Union argument. We are here to try to solve the problems of

* Professor Finer cited as an example a recent refusal by technicians to operate the computers at London Airport, with resulting and entirely predictable chaos for air travel in and out of the UK.

the future; let us try to do something good."

Dr. Margulies gave some facts about present unemployment in Western Europe (8 millions out of work) and in the OECD area as a whole (18 millions). In view of this it was not surprising that the new age of technical and scientific progress, originally welcomed with great expectations and enthusiasm, was now regarded by many with fear and even hostility.

But was this not consistent with progress? "Throughout history" said Dr. Margulies, "man has unceasingly tried to improve conditions of life; he has permanently invented and applied new means of production to make work easier, better and more efficient, thus emancipating his material existence from constraints imposed by nature. And each step in that direction meant killing of old jobs and advances into new spheres of human activities."

Unfortunately, such changes had always brought severe problems. Between the killing of jobs and the development of new ones, there had been periods of unemployment, displacement, poverty, unrest and disaster. But from the fire had arisen new methods of human cooperation, new kinds of relationships . . . complementary organisational and societal structures to overcome old-established hierarchies and privileges. The Phoenix was never reborn without pain and grief, without resistance from existing societal structures, or without considerable delays. Nevertheless the rebirth had taken place, and it was the *duty* of those close to the problems to be sympathetic and understanding midwives.

Pleading against any return to Luddism, Dr. Margulies concluded: "We need modern technology, not to displace man, but to return man to his human capacities to think, to act consciously and creatively . . . and if things go wrong, we should not blame the computer, we should blame our society."

This strident call to duty prompted Professor Murray Eden (National Institutes of Health, Bethesda) to draw attention to what he called the pernicious tendency, throughout society, to foster the idea that science could and would solve all problems. This could only be true of Science (with a capital S), embracing all human understanding and endeavour. It was patently untrue that, for example, computers and AIP were alone the keys to a golden future: if that future was not materialising, the blame clearly lay elsewhere.

Thus the general concensus of the meeting seemed to recognise – despite some previous contrary suggestions – that mankind was still fundamentally in charge of his destiny, and that when he saw disaster ahead he had only himself to blame . . . and only himself to take remedial action.

Almost in parallel with this main disucussion of the day (but no less important for that reason) were several interventions relating to the *technology* of AIP, and to its applications to specific problems. Thus Professor Shuhei Aida (Tokyo University of Electro-communications, Director of the Honda Foundation and Vice-Chairman of the Symposium) gave a stimulating account of new research into computer-based graphical methods of expressing human perception and attitude in an artistic (right neocortex) fashion rather than relying only on digital formulations. The "Faces Method" for data display is a system of pictorial expression of multidimensional data. Professor Aida described its use in representing political relationships between the United States and the USSR, relationships which defy precise formulation by conventional mathematics but are susceptible to "fuzzy analysis".*

Professor Umberto Pellegrini (Milan University) compared the technologies and effects of AIP in the 1960s and 1970s, and offered some possible prognostications for the 1980s. He showed how initially, when remote terminals were comparatively rare and computers large and expensive, there had been a tendency to centralise information processing systems, which reinforced a parallel tendency to centralise bureaucratic administration

* A description of "fuzzy set" analysis was given at the first "Discoveries" Symposium in Tokyo by Professor Toshiro Terano, of the Tokyo Institute of Technology, who further expanded this theory of "holistic symbolism" at the subsequent Symposium in Rome. Professor Terano was also present in Stockholm, and presented a remarkably stimulating paper as part of the "end of day" discussions of the present (4th) session . . . see later.

(whether in the public service, in service industries such as banking, or in commerce and industry).

However the arrival of cheaper machines and mass-produced terminals had entirely reversed this trend, and today AIP technology was the technology of distributed systems, leading to a similar decentralisation of the "human component". Professor Pellegrini saw this trend continuing in the future, even to the point of decentralising some manufacturing facilities, as well as service industries.

Professor Toru Yoshimura (Saitama University) gave details of the use of AIP in Japan for improving policy-formation functions in public administration. In a most learned but complex address, he showed how a very carefully constructed system of data collection, analysis and processing was being used to improve the efficiency of overall administration and management in local (i.e. decentralised) government. In this his country appeared to be (once again!) well ahead of most others, for having used a fully centralised system to "catch up with the social development patterns of advanced Western Countries", decentralisation and "healthy competition among various (local) entities" was now returning to all such entities an interest in developing their own special answers to their own special problems. The very opposite of deadhanded central control.

Also of considerable practical interest in the same context was an account by Ingar Palmlund (Deputy Director General of the Swedish Agency for Administrative Development), of the use and impact of AIP in the Swedish public sector. The list she gave of activities in which AIP was now being applied was as impressive as it was comprehensive, and left no doubt that Sweden is in the vanguard of these developments. However she sounded one note of caution which could well have implications for other countries without an indigenous computer industry. "A country without an advanced electronics industry" she said, "but with a high degree of automated information processing . . . is very dependent on foreign commercial and political powers. In times of peace and stability this is generally not considered a major problem. However, it increases the vulnerability of the country and may be a serious threat in times of conflict on the world's political arena."

Fortunately, the rapid spread of the technology, and the growing availability of equivalent equipment from many souces, must surely reduce this somewhat sensitive dependence without very much delay.

As a final excursion into intellectual analysis of relationships between man and what has been called the "information society", Professor Toshiro Terano (Tokyo Institute of Technology and, as already noted, author of previous papers on Fuzzy Set theory) spoke of the symbiosis between man and machine-systems leading to the latter becoming a "supplementary brain". The idea of AIP as an extension (prosthesis) of the left neocortex had earlier been discussed by several speakers (notably Professor Harold Linstone) but the extension considred by Professor Terano was more than this. It was no less than the provision to individual man, through a highly efficient electronic information system, of what the Professor called an "ectosomatic brain", in addition to his individual brain. This additional brain could be envisaged as containing – eventually – all human knowledge ever acquired, retrievable more or less instantly from the vast "ectosomatic" memory in an analagous manner to recall of learnt information from the human memory.

This most exciting proposition was surely one of the highlights of the Symposium, the ramifications of which must spread into every branch of science, art, philosophy and indeed religion. Perhaps for the first time it brings rational argument to support belief in mankind's future, by offering a way whereby all mens' knowledge could be transferred from generation to generation, to be used and built on by all subsequent generations.

The implications of such a development expand as rapidly as thought about it, yet it is to be noted that there is no suggestion of the ectosomatic brain taking over control of any function currently demanding human imagination, judgment, intuition or creativity.

As Professor Terano concluded: "It is predicted

that the effect will be immeasurably great."

No account of this last working day of the Stockholm Symposium would be complete without mention of several interventions from Dr. Letitia E. Obeng, of the Ghana Academy of Arts and Sciences and Senior Officer of the United Nations Environment Programme (UNEP). Speaking with evident personal conviction, Dr. Obeng reminded this meeting of super-advanced technologists and sociologists, debating the impact of super-science in a world where even the most developed countries are not sure of their reactions, that a major part of the world is still short of such elementary requirements as enough fresh water, let alone enough food and protection against disease.

For such countries, she said, AIP as it had been described and discussed could clearly offer some advantages (e.g. in forecasting population trends, or in the rapid identification of insect pests through a computer data-bank). But if it was agreed that technology – whether very or less advanced – should be used for the "general good", it was necessary that the general good be defined with the help of the developing countries of the world, and not in their absence. No super-intelligence was required to appreciate that our most precious planet was, in the words of Ambassador Takeso Shimoda, Honda Foundation President at the opening of the previous Symposium in Paris, "a single village".

AUTOMATIC INFORMATION PROCESSING SYMPOSIUM: CLOSING SESSION

The closing session of the fourth "Discoveries" Symposium, on Friday morning 17th August 1979, took place in the Parliament Building in the centre of Stockholm. Unlike the previous working sessions, it was open to the public and the press. It took the form of a review of the "Discoveries" Project since its beginning in 1976 in Tokyo.

The session was chaired by Professor Gunnar Hambraeus, Managing Director of the Swedish Academy of Engineering Sciences (the IVA). It began with a review of the three previous symposia (Tokyo 1976, Rome 1977, and Paris 1978), presented by Professor Eduardo Caianiello (Salerno University) who had been present at each meeting and had chaired the Organising Committee in Rome.

Professor Caianiello's address was however much more than a simple summary. In his own words, that would have been a photograph . . . already given in the reports which had been distributed. His intention was to *paint a portrait* of the "Discoveries" Project, how it began, what it had attempted and what it had achieved.

"Discoveries" had begun in all humility ... the humility of a small group of people meeting together in the shadow of world crisis. If some of these people were from the Western World, the inspiration was entirely oriental: an inspiration based on study and reflection, not declamation and immediate action. The Japanese sponsors, said Professor Caianiello, explained this attitude as "trying to optimise harmony", and to that objective they (and especially Dr. Honda himself) had devoted themselves with the utmost sincerity. Not sincerity in the normal Western sense, but sincerity in the Eastern sense of total dedication.

The Project had started with no absolute beliefs, but with a deep desire to learn from others, to study and to think. In this way all concerned had hoped for increased understanding – a first and yet so often ignored prerequisite of rational action.

The Professor described in some detail the subjects discussed at the first Symposium in Tokyo, noting with pleasure that many of those then present (like himself) were also now present in Stockholm. That first meeting had been generally regarded as successful, but clearly only the beginning of discussions which, to yield fruit, must continue.

Hence the subsequent Symposia in Rome, Paris, and now Stockholm, which must all be regarded as parts of a developing whole. The details of these meetings were recorded in the published literature.

Professor Caianiello, speaking slowly, softly, and with obvious dedication to the Project to which he had contributed so much, ended by expressing – on behalf of all present and all others who had been associated with "Discoveries" – the deepest appreciation and gratitude for Dr. Honda's inspired creation of this remarkable adventure in multi-cultural, multi-disciplinary cooperation.

Thanking also Professor Hambraeus and his committee for their work in organising the Stockholm meeting, Professor Cainaiello was sure that the spirit of "Discoveries" had been fully maintained over the past five days.

Separate summaries of the Stockholm Sessions were then presented by those who had led the work:

- Professor Sixten Abrahamsson for the Case Study of Medical Care;
- Professor Erik Sandewall for the "Machines" Session;
- Professor Torgny Segerstedt for the "Individual" Session;
  and
- Professor Gunnar Heckscher for the "Society and Computers" Session.

Ambassador Takeso Shimoda of the Honda Foundation then took the floor to record the Foundation's satisfaction with the outcome of the Symposium. Further, Ambassador Shimoda read a *Declaration* of the Foundation concerning future intentions. This declaration is annexed to the present report: it does not record that the funds for the announced HONDA PRIZE (like the funds for the continuing Symposia) have been and will be provided as part of Dr. Soichiro Honda's personal dedication to the Project.

Finally, and to close the Stockholm meeting, Professor Hambraeus reviewed briefly its achievements.

First, he said, technology had been shown a true fruit of the Tree of Knowledge, to be used by man

for good or for evil.
Second, the latest developments in Advanced Information Processing and related fields were correctly considered as no less significant than the Industrial Revolution.
Third, these developments engaged the responsibility of all concerned: from the scientists to the politicians. There was no excuse for avoiding this responsibility – in the case of the scientist to explain, in the case of the politician to understand. For without understanding there could be no soundly-based decisions.

In launching the "Discoveries" Project and programme, the Honda Foundation had undertaken a responsibility of the profoundest nature. It had provided a crucible for melting, testing, and where necessary reshaping attitudes to advanced technology in the social context, and to sociology in the face of advanced technology.

"Discoveries" had not attempted this on the grand scale of a huge international organisation. Such organisations already existed and the Project saluted them and their work. But the "Discoveries" method was rather to throw a small pebble into a lake and watch the effects of the spreading ripples; to sow a small seed and watch for its fruit.

Professor Hambraeus concluded by again thanking Dr. Honda, the Honda Foundation, and all concerned with the Stockholm Symposium, for their contributions to a true gathering of intellects and a true refining of ideas. None of those who had been privileged to take part in the meeting could possible have disagreed.

TERMINAL PRINT-OUT

When data processing is automatic
and the data bank is out of your control
And every action has to be pragmatic
You'll all too easily end in a hole . . .
But, if you have no terminal connection
Transcending your intelligence by far
And giving you superior direction,
You'll never know how badly off you are.

By Bruce M. Adkins
Stockholm, August 1979

ANNEX

"DISCOVERIES" DECLARATION

Honda Foundation
Stockholm, August 17, 1979

The ardent desire of mankind today is to create a civilization in which utmost respect is paid for the human being as such, and this will be possible only with mutual support and concerted action among the intellectuals of the world, especially among scientists and technologists.

The Honda Foundation, inspired by this philosophy, has sponsored the "DISCOVERIES" International Symposia, first in Tokyo, then in Rome, the cradle of civilization, and Paris, the capital of culture, and now in Stockholm, this serene guardian of academic and scientific achievement.

At these symposia we have discussed the catastrophe deemed inherent in modern civilization, recognized the megacrisis which will sooner or later confront mankind, and, in order that mankind may overcome that crisis, made comprehensive studies of the fundamental prerequisite for human activity, that is, information and communication.

The purpose of "DISCOVERIES" activity is to identify the real problems facing the mechanical and technological civilization of today, to discover the methodology which will enable us to cope with them, and to set a stage for the concentration of the wisdom of mankind on the task.

To achieve this purpose, we now declare that we shall:

1. Promote international technical cooperation for the establishment of *Eco-Technology*

   The aim here will be the establishment of a technology which will truly serve humanity, *Eco-Technology* being a concept which includes appropriate technology.

2. Establish a HONDA PRIZE

   It will be awarded each year to a person who has made an internationally recognized achievement in the field of *Eco-Technology*, with an additional prize of ten million yen (¥10,000,000) going to the same person.

3. Continue the "DISCOVERIES" International Symposia

   These will continue to be held, as the need arises, in connection with the field of *Eco-Technology*.

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