

COMPUTERS AND AUTOMATION

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SOCIAL RESPONSIBILITY AND THE COMPUTER PROFESSIONAL. THE RISE OF AN IDEA IN AMERICA. PART I.

GUSTAV METZGER

This article seeks to trace the rise of a movement within the computer profession. It is based on three key documents: The Journal of the Association for Computing Machinery (ACM); the Communications of the ACM; the magazine Computers and Automation.

In January 1958, a letter appeared in Computers and Automation condemning the employment of computers in weapons of mass destruction. The magazine then opened its pages to a discussion of this area in relation to the responsibilities of the computer professional. Ever since, the magazine has been engaged in a campaign on this issue. Computers and Automation is also of particular interest to artist since it was the first publication in the world that actively encouraged computer art, by arranging a computer art contest in 1963, which continues to the present day.

The appended bibliography contains all the key references that have appeared in Computers and Automation and in the Communications of the ACM. In the case of the former, the bibliography traces the origins of the controversy and its development; it includes related areas such as the privacy issue. With the latter publication a conscious attempt was made to list every article, news item etc., that contains

the term social responsibility. Beyond this, other issues, such as privacy, law enforcement, are included. The article and bibliography is presented with the hope that it will enable the movement to make further progress.

It is quite certain that next year will see a great upsurge of activity. In protest against the decision to hold the 1971 annual meeting of the ACM in Chicago, several hundred members are organising a 'Counter-Conference' in Boulder, Colorado. This is the most extreme challenge presented to the ACM on the issue of social responsibility, and is sure to lead to the strengthening of the campaign. (More information on the Counter-Conference elsewhere in this issue of PAGE.)

The theme of the 1971 Spring Joint Computer Conference, Atlantic City, May 18-20 will be RESPONSIBILITY. Whilst one can expect the majority of the papers on the given subjects like data files; law enforcement and the judiciary; national policies; the techniques and practices of embezzlement to be angled in favour of maintaining the trend towards an integrated authoritarian computer-linked kind of social system, the theme will inevitably permit the extensive discussion of an alternative approach.

There cannot be any doubt that computer professionals have been informed about the relations of the computer to government and the military. In his welcoming address to delegates at the Western Computer Conference, Los Angeles, February 11-12, 1954, D.H. Lehner, University of California, said: 'Until recently, the driving force in the computer field has been the U.S. Government.' At the Eastern Joint Computer Conference, New York, December 10-12, 1956, H.T. Engstrom, of the National Security Administration, in the Keynote Address, made this point: 'As you all know, the great impetus to this art (computing) came from the military during World War II.'

In the Foreword to the Proceedings of the EJCC, Philadelphia, December, 1958, Frank E. Heart, MIT/Lincoln Laboratory makes these remarks: 'Perhaps it is only a convenient rationalization, but I still find the computer field an exciting and stimulating domain. The excitement about the computer arises in much the same way as the excitement about atomic energy; one may almost *feel* the changes being produced in society. This eulogy on behalf of the computer—so revealing of the destructive potential locked up within the area—continues: 'However, for me, the most exciting applications are those which threaten (sic) to affect all aspects of human progress. I would like to point towards two such potentially pervasive applications—two impending applications that excite me considerably. 1. The application of the computer in studying and copying the characteristics of biological systems. 2. The library computer concept.' MIT's Lincoln Laboratory is one of the chief centres for research in the military applications of computers. A note at the foot of Ivan E. Sutherland's pioneering 'Sketchpad' paper indicates that the Lincoln Laboratory 'is operated with the support of the U.S. Army, Navy and Air Force'. (1963 SJCC)

For an insight into the way armament developments integrate with a capitalist economy, we can turn to a paper by W.W. McDowell, Director of Engineering, International Business Machines Corporation: 'This possibility is well illustrated in the current trend towards the "systems concept" for the development of weapons. A plan of this sort—a scientific balance between all phases of the problem will inevitably lead to the most efficient results. Is it not far more likely that this same overall scientific approach will also in the case of business machines provide the most efficient and significant solution?' (1954 WJCC)

Darwin E. Ellett, Colonel USAF, continues with the exposition: 'The future of our systems work holds almost unlimited potential for gains in industrial efficiency, and that resulting benefits will continue to justify the expenditure of the required resources to achieve them. However, I cannot leave the subject at this. If there is a real reason for promoting this efficiency it can be none other than the betterment of human living whether through better defense of the nation, improvement of the standard of living, relief from manual drudgery, or whatever the specific and valid aim.' (1959 WJCC)

The Vice Chairman of the 1958 WJCC, H.T. Larson, tells us that there are three major areas in the computer field; Science and Engineering: Military Control Mechanisms: Business Data Processing.

But the toughest presentation of the links between the development of the modern computer and war requirements comes in the 1957 Western Computer Proceedings. The theme of this Conference was 'Techniques for Reliability'. The Keynote speaker was James M. Bridges, Office of the Assistant Secretary of Defense, Washington, D.C., and his subject: 'Techniques for Reliability in Computers for Weapon Control.' This article, with its religious fervour, must be read in its' entirety. (1957 WJCC)

Old soldiers never die...but in 1964 the National Bureau of Standards 'formally retired' the famous computer SEAC: 'Originally developed to enable the Air Force to solve the massive logistics problems, it was also used to produce the first H bomb.' And to end this section on a sentimental note, *Communications* prints a letter from West Point Military Academy, appealing for donations of pictures of old computers. (115) (106)

ACM-62 was officially opened by Maj. General Henry Vicellio, Commander of the 26th Air Division of SAGE, stationed at Hancock Field, Syracuse, near the venue of the National meeting; we see a picture of the General cutting the ribbon to open the event. Walter Finke, President of Minneapolis-Honeywell was the Keynote Speaker; his theme, "Social and Educational Aspects of EDP." 'With the battle of economics replacing the cold war, the computer is brought into the area of the politician.' 'Further, the computer industry is indispensable to our defense program in the world and indispensable to space control.' (105) ()

'Computers—A Key to Total Systems Control' was the theme of the EJCC, Washington, December, 1961. Previous meetings had been sponsored by the National Joint Computer Committee, but this was the first to be sponsored by the recently established AFIPS. President of Remington Rand, Dause L. Bibby, in the Keynote Address 'Computers and World Leadership' made it clear who was 'leading'. 'One top U.S. physicist with an advanced American computer can outproduce 1,000 Russian engineers.' 'Russia is graduating ten times as many engineers annually as the U.S., but we have a tool, the computer, that fills the gap. America today holds a commanding lead over the Soviet Union in computer technology. Although the lead has shrunk, we can keep it—and enlarge it—if we ourselves do not fall victims to complacency.' (99)

The leaders of the computer profession are quite conscious of the extensive power contained in their organisations. At the EJCC, Washington, December, 1961, the then recently created American Federation of Information Processing Societies—AFIPS, was announced as 'the unified national voice for the information processing and computer profession in the U.S.' ()

When IFIPS—International Federation of Information Processing Societies is launched in the Spring of 1961, this is the image that is projected: 'Although the field is only 15 years old, information technology already has become a multi-billion dollar business with far-reaching effects on all nations of the world.' 'For the first time, a world organisation is now entirely actively fostering the growth of the information processing sciences. This organisation is one of the most important new developments for the future of technology and mankind. The American representative is the National Joint Computer Committee (NJCC) of the ACM, AIEE, and IRE.' (93)

Later in the year, the first President of IFIPS, the American Isaac L. Auerbach, contributes an article 'The International Impact of Computers' to the *Communications of the ACM*. The nauseating chauvinistic tone that we have come to associate with pronouncements by leaders of the American computer profession is particularly out of place here, coming from the recently elected head of an *international* organisation that includes Russia and the Eastern block. Auerbach continues the theme of power: 'It is my firm opinion that the positive impact of information technology on the average man will far exceed that of atomic energy or any other aspect of science in the remainder of our century.' (96)

The American computer profession is focused on two bodies; the Association for Computing Machinery—ACM, and the Joint Computer Conferences.

ACM started in 1947 as The Eastern Association for Computing Machinery and is the biggest organisation for computer professionals in the world. It is easy to take the first letter to stand for American, but in fact 68 countries are represented, and about 2,500 members—9.4% of the membership—are abroad. Earlier this year a European Region was formed with about 1,000 members. The Association arranged annual meetings, and in January 1954 launched the Journal of the Association for Computing Machinery. In January 1958 a new publication was started—the Communications of the Association for Computing Machinery. Both periodicals are in existence, the Journal being a quarterly, whilst the Communications appears monthly, and carries news items, reports on Council activities, business developments, as well as longer articles.

The Digital Computer Newsletter of the Office of Naval Research is one of the first periodicals devoted to the computer. It started in 1951, on a modest scale—Vol. 2 No. 2 May 1951, consists of four pages. It appeared quarterly, and when the Journal of the ACM was begun, the Digital Computer Newsletter was reprinted as a supplement so that it could reach a wider audience. When the Communications of the ACM appeared the reprinting of the Newsletter was transferred to that publication. On that occasion the following announcement was made. 'The NEWSLETTER is circulated to all interested military and government agencies and the contractors of the Federal Government. In addition, it is being reprinted in the Communications of the ACM. The Office of Naval Research welcomes contributions to the NEWSLETTER. Your contributions will assist in improving the contents of this newsletter, and in making it an even better medium of exchange between government laboratories, academic institutions, and industry. It is hoped that the readers will participate to an even greater extent than in the past in transmitting technical material and suggestions to this Office for future issues.' The statement is signed, Editor, Gordon D. Goldstein, Office of Naval Research, Mathematical Sciences Division. The last copy of the Newsletter in the Patent Office Library, London is dated July, 1968, Vol. 20 No. 3. The Editor is still Mr. Goldstein. In May, 1961, the Newsletter ceases to be included in the Communications due to 'space limitations.' Indeed the Newsletter had grown considerably since its first issues.

But then growth is the overpowering feature of the computer field. One has only to compare the first slim publications of the proceedings of the Joint Computer Conferences with the bulky volumes of recent years. The meetings start with the Joint AIEE-IRE Computer Conference, Philadelphia, December 10-12, 1951. The Conference is sponsored by the Committee on Computing Devices of the American Institute of Electrical Engineers, the Electronic Computers Committee of the Institute of Radio Engineers, with the participation of the ACM. At the next Joint Conference in New York, December, 1952, the ACM begins to function as a sponsor. From February, 1953, the Conferences become bi-annual events, alternating between the East (EJCC) and the West (WJCC) of the country.. With the formation of AFIPS in 1961, the titles are changed to Spring Joint Computer Conferences, and Fall Joint Computer Conferences—SJCC and FJCC.

Who attended these early meetings? In 1955 the membership of the ACM was approaching 2,000. A report on the 10th National Meeting of the ACM at the University of Pennsylvania, 4-16, September, 1955, where 129 papers were presented, gives this breakdown. 'About 1,700 members and non-members of the ACM attended the sessions. Close to 50% of the attendees were non-members. Almost 40% of the registrants were from banks, insurance companies, public utilities, oil companies, mail-order houses, and large industrial organizations. About 25% were scientists and engineers in industry and universities while a similar number were from government and military.' ()

COMPUTER ARTS SOCIETY, AIMS AND MEMBERSHIP

The aims of the Society are to encourage the creative use of computers in the arts and allow the exchange of information in this area.

Membership is open to all at £1 or \$3 per year; students half price. Members receive PAGE and reduced prices for Computer Arts Society public meetings and events. The Society has the status of a specialist group of the British Computer Society, but membership of the two societies is independent.

Libraries and institutions can subscribe to PAGE for £1 or \$3 per year. Extra copies will be sent to the same address at half price. No other membership rights are conferred and there is no form of membership for organisations or groups. Re membership, subscription, circulation and information; write to Alan Sutcliffe.

COMPUTER ARTS SOCIETY ADDRESSES

Chairman: Alan Sutcliffe, ICL, Brandon House, Broadway, Bracknell, Berkshire.
Secretary: John Lansdown, 50/51 Russell Square, London W.C.1.
Editor of PAGE: Gustav Metzger, BM/Box 151, London W.C.1.
Dutch Branch (CASH): Leo Geurts and Lambert Meertens, Mathematisch Centrum, Tweede Boerhaavestraat 49, Amsterdam, Holland.

RENEWAL OF MEMBERSHIP

If you joined the Society before October 1969, your second year's subscription is due now—unless of course it has already been paid. Members of the Society who joined in April, May or June 1969, and who do not now renew their membership will not in future receive copies of the bulletin. Members are asked to renew their membership when it falls due; JM Sutcliffe, 4 Binfield Road, Wokingham, Berkshire.

QUICK RESPONSE. Under the heading ARTISTIC ENDEAVOUR the American Computer magazine DATAMATION had a short notice about CAS and PAGE, with an invitation to circle 360 on the reader's card for more information. Within a few weeks of publication 350 computer-printed address labels had arrived in England, and sample copies of PAGE dispatched. DATAMATION has recently changed to a semi-monthly; the notice on CAS appeared on the 15 August.

LONDON

Computer 70 at Olympia, 5–9 October will have an international exhibition of computer art presented by CAS. The central feature of this mammoth show will be a 'COMPUUDOME' designed by the Computer Arts Society, in conjunction with Foundation General Systems Ltd. Members of the Society may buy tickets for this event at the reduced price of 5/- (normal price £1). Having obtained a ticket (from John Lansdown) a guest may accompany you. (Note to readers; The Times; The Financial Times; Science Journal, and other publications will have special features on... guess what. If you watch cathode ray tubes, Twentyfour Hours are planning to present computers nightly during the week.) Public relations for Computer 70 are handled by: D.E. Evans, Leedex Ltd., 100 Whitechapel Road, London, E.1. Tel: 01-247 6525.

SOCIETY MEETINGS

14 October 1970. Gareth Jones. Linguistics—an Eye-witness Account.
4 November 1970. John Latham. Artists Placement Group.
17 November 1970. Steve Willetts. The Artist as a Structurist of Behaviour.
2 December. Stroud Cornock and Ernest Edmonds. Progress at Leicester in the Development of Software Packages for Artists by the Combined Study Group.
All meetings start at 7.30pm. Except for the talk by Willets, they fall on a Wednesday. At the British Computer Society, 29 Portland Place, W.1. The meetings are open for members and guests.

PAGE

A note to the new reader. Thousands of copies of this number are being distributed at Olympia at Computer 70. Normally, PAGE consists of one sheet only.

Statements made in the bulletin do not necessarily represent the views of the Computer Arts Society. In the next issue of PAGE we wish to print news and statements relating to recent work by members of the Society. We also would like to have articles on new developments related to computers/applications. Please confine contributions to 800 words, and send as soon as possible. We would particularly like to publish information from members living outside Britain. PAGE is now on sale in London at the ICA bookstall, the basement of Better Books, and the computer section at Dillons.

ECOLOGY IN THEORY AND PRACTICE

A course of lectures at the Institute of Contemporary Arts, London, October 1970–March 1971. 22 lectures will be presented. Subjects treated include; Population; Food; Sewage; Conservation and Wild Life; Marine Ecology; Industrial Pollution; Drugs and Chemicals; Radioactivity; Chemical and Biological Warfare; The Politics of Ecology. Speakers range from Dr. N.W. Pirie, to Professor Barry Commoner. The American and Soviet Embassies have been asked to send lecturers to talk on their respective countries attitudes towards world ecological issues. The Lecture Organiser is Jonathan Bentall. The lectures will be published by Longman in the autumn of 1971.

The lectures take place on Wednesday evenings at 8 p.m. starting 7 October. Season tickets are on sale now. Tickets for individual lectures will be on sale when available. Readers who want to attend are advised to apply immediately, as tickets are likely to be taken up very fast. Contact Ann Lauterbach; 01-930 0493.

For information on the ACM Counter-Conference 3–5 August, 1971, at the Harvest House Hotel, Boulder, Colorado, write to: David E. Burmaster, Room 803, 545 Main Street, Cambridge, Mass., U.S.A. A letter by Burmaster appears in the August number of Computers and Automation. The August number also contains this year's computer art contest.

Workshop on the Data Bank Society

A Conference convened jointly by the National Council for Civil Liberties (NCCL) and Allen & Unwin Limited. To be held at the Bloomsbury Centre Hotel Coram Street, London WC1 on Wednesday 18th and Thursday 19th November, 1970.

The NCCL has been concerned with the issue of computers and privacy for over two years and we have now decided to convene a high level conference to bring together representatives of Government and industry for an intensive and constructive study of the problems and possible solutions. The conference also stems from the impending publication of a book by Dr. Malcolm Warner and Michael Stone entitled "The Data Bank Society", published by Allen & Unwin Ltd.

The data banks are now being built up in government and commercial enterprises will exercise a profound effect on the course of both our individual and collective lives for decades to come. They could be as beneficial as penicillin or as dangerous as the machine gun.

As yet, practical experience of the use of data banks in the full computer sense is limited. In the past such data banks as existed, and they do, have been under manual control with all the resultant inefficiency that human handling can mean, but benefiting from the direct personal contact of their operators.

In the future such data banks will be under more remote control, and once established as working systems, will be nearly as unalterable as the Laws of the Medes and Persians.

It is now, immediately, that the technical, legislative, administrative and ethical rules must be established by which such data banks are implemented.

Fees. The inclusive fee for attendance in an individual or organisational capacity will be 20 guineas. The inclusive fee for attendance as a representative of a company will be 30 guineas. Conference facilities and services will include: Morning Coffee. Lunch. Afternoon Tea. Reception (18 November). Secretariat. Printed Working Papers. Recording Equipment.

Miss Sarah Dickinson, Workshop Secretary, The National Council for Civil Liberties, 152 Camden High Street, London, N.W.1. Telephone: 01-485 9497.

The final meeting on 19 October 7.30–10 will be open to anyone. Tickets for this meeting will be 10s.

In particular, it is the aim of the organisers that both the special and general sessions will result in the production of a final workshop study which will accurately reflect the attitudes of all participants. A study which will provide them, and others, with a personal guideline in dealing with the problems of the data bank society, and which may indeed be significant in ensuring that in our striving for a more integrated society, in which the data bank in all its forms will be a key part, we do not produce a data pollution problem for coming generations.

Draft programme

WEDNESDAY, 18th NOVEMBER, 1970

Paper 1—The Problem: the role of the computer industry. Paper 2—The views of a user—Government. Paper 3—The views of a user—Commercial. Paper 4—The American experience. Paper 5—The European experience. Working groups: (a) Technical concepts (b) Legal and legislative (c) Professional management ethics. Reception. Dinner.

THURSDAY, 19th NOVEMBER, 1970

Working groups, discussions and further presentations. Plenary session: report from groups. General discussion. Paper 6—Limits of responsibility: The industry, the individual. Open Forum. Chairman's closing address. Press Conference. Discussion Meeting—Delegates and invited audience.

A NEW SORT OF COMPUTER?

GORDON HYDE

"The fourth generation of computers is as yet unborn and is likely to remain so, because the emphasis is shifting toward computer usage rather than computer design". This statement by Donald McIlwain in "The Guardian" is typical of the point of view of people whose thought is dominated by the role of the computer as a business machine. Unfortunately, this particular area of application is unlikely to realise more than a tiny fraction of the true potential of the concepts that underlie the development of the computer, since the world of business is conservative and traditionally several decades behind real technological and social change. Up to now, the vast majority of computer applications has been concerned with the mechanisation of operations, which, whilst they might be too large, too lengthy or too complex for human capability, involve little or no innovation. In the sense therefore that we have been concerned with what the computer can do in the present, Donald McIlwain is correct, but to see this as the sole, or even the most important area of development for the next decade, would be disastrous. The computer should be seen in the widest sense as a prosthesis of the human brain in its innovative and creative as well as its house-keeping roles. In this context, it is as instructive to look at what the computer of the present day cannot do, and it is from this point of view that my own work takes its departure.

The computer of the present is a numerical processing machine; even when we are not directly concerned with computation as such we are still using a number-theoretic machine in the sense that we place the symbols we are using in a one : one relation with binary equivalents of numbers and then find an algorithm or logical equation which will simulate the relations of the "real" elements. Thus whilst we may appear to be using different sorts of symbols, alphabets and concepts, we are really using the familiar numbers and equations with different hats on.

Now the analytic number-theoretic approach is fine as long as we are dealing with things which behave like or can be described in terms of linear algebras, algebraic geometries or Boolean logics and which we can define in terms of a set of "a priori" rules and a phrase-structure (sequential one step at a time) grammar, like a computer programme. But there are immense categories of highly significant phenomena which do not fit linear equations, do not behave in orderly fashion like numbers, do not form number-like or Boolean sets, and which undergo continuous transformation in time. The brain and its subsystems that give us language, music, the Arts and mathematics itself, and human society; are all examples of open-, evolving-, syntactic- and quasi-non-deterministic-systems. We cannot describe such systems completely from a knowledge of their parts and past history and a set of "a priori" rules, as we can with a number-theoretic system, nor can we generate them by a simple phrase-structure grammar like a computer programme.

It is my view that the distinction between deterministic and quasi-non-deterministic systems marks the limits of both our existing computers and much of our existing mathematics. Indeed, almost all the limitations of the present day are related to unsolvable or undecidable problems in number theory. Nevertheless, the brain, a physical device with many of the characteristics of a digital symbol processing machine, is a quasi-non-deterministic device, and if we are not to assume a metaphysical process, its phenomena must arise from discrete operations. My most recent work has attempted to find an abstract symbol processing machine which would simulate those operations.

The basic difference between the two types of system is that the quasi-non-deterministic system continuously evolves its structure by learning changes of state, whereas the deterministic system has the whole of its structure predetermined by its "a priori" rules, whether these are so-called natural law or a computer programme. I use the term quasi-non-deterministic (qnd) rather than non-deterministic deliberately to dispose of the idea that evolutionary processes and creation of "new" forms is the result of randomness or accident, or that organisation can only arise from "a priori" axioms of the system.

The kind of system we are looking for will be able to observe its own history in terms of changes of state, relate its current state with its previous changes of state, synthesise any possible future change of state in relation to the "grammar of its history", and control itself in such a way as to "choose", "find" or "create" external conditions which confirm its history or generate "new" patterns which extend its evolutionary potential. The key to the whole system is that it should be able to "observe" itself and in so doing observe the "real" world and its possible future.

The first problem we meet in attempting to design such a system is that it cannot be a single machine, with a single language and a phrase-structure grammar. It has to be a hierarchy of machines that observe and describe one another, and although the actual input of each machine will be finite and denumerable, its states will always be "choices" from a non-denumerable infinite set, since we can never know "a priori" whether a particular configuration is valid or will actually occur. Thus we have to assume that all "events" and related states of the system are equally probable at the outset, although we know that as the machine "learns" some states will become more or less likely and provide a basis for probabilistic behaviour.

Now it is clear that if the "language" of every machine in our automaton is to be a non-denumerable infinite set, every machine will need its own machine-recognisable language equivalent to the set of real numbers, which sounds like nonsense, since we are asking for new categories of computable symbols which are distinguishable from "numbers". It will also be necessary to be able to operate in this field of infinite languages with procedures that do not involve an impossible amount of computation. The answer to this problem proves to be simple and remarkable, and is already implicit in the way in which we use binary configurations to represent symbols in the computer.

Consider the uncountable infinite set (c) of the real numbers (decimal fractions, Euclidian points on a line). We can represent any real number in the continuum as a string of binary configurations, so it is not too difficult to envisage a continuum of strings of 4-bit states equivalent to the hexadecimal real number continuum. If we now take this continuum of 4-bit states and add a 0 to the left of every character, we create another uncountable infinity which is an isomorphism of the 4-bit continuum on the first 16 characters of the 5-bit alphabet, and if we add a 1 instead of a 0 to the 4-bit characters, we create a similar isomorphism on the second 16 characters of the 5-bit alphabet. But what of the continuum which is the uncountable infinite permutation group of all the 5-bit characters? This will include all strings which have elements from both the isomorphic subsets of the 5-bit alphabet, and, since all the possible strings of our original set of 4-bit symbols are represented in the isomorphic subsets, we no longer have any representation of these "new" elements in our original continuum. In other words, we have binary strings which cannot be real numbers, but nevertheless are computable, susceptible to the diagonal proof of uncountability, and have parity by virtue of the fact that the least significant character of the string will be 0 or 1.

Now all this sounds a bit like black magic, but what have we done? We have made the same assumptions about all symbols, and in particular about the composite symbols, the binary configurations, that have hitherto been applied to the transfinite sets of number symbols. We have also shown that if we are allowed to cleave the line of Euclidian points into segments of equal length (make an infinite number of Dedekind cuts), then there is a hierarchy of binary continua of higher cardinality than the continuum of real decimal numbers.

This all sounds very abstract of course and far removed from practical models of machines we might eventually be able to build, but in fact we have almost built the basic design. Consider the original input in terms of 4-bit strings; by adding a zero to the left of every character we convert this into the input to the 5-bit "machine" which performs an operation which describes that input in terms of its own "grammar" which uses "new" strings, not isomorphic with the input set and recognisable by the system as a whole as a "state statement" of that specific machine. In fact we can envisage a hierarchy of these transfinite automata, either processing input data in different ways or describing one another's output. The work of Lars Lofgren and Paul J Cohen (2,3) would also seem to imply, that if we can perform the operation I have described above, then we can use extended set theory ZF2, which includes the "axiom of choice" essential to a quasi-non-deterministic system.

The next stage of the work was working out the "grammars" for the machines. These are generated by parallel addition of sequences of input strings which are imposed on a pseudorandom matrix (4) which performs the transform onto the "machine state set" and in combination with a shift function, decorrelates complementary bits in the generation of the "serial order describing mode". All operations are carried out from left to right, thus carry bits permute the characters and the characters subsets in a string.

The present model of the qnd automaton with which I am working has three "machine" modes; 1) an input set defining or analytic transform mode, which defines the input set structure in terms of a Boolean function irrespective of temporal order 2) a serial order defining mode which gives a unique statement for every serial ordering of a given input set 3) a generic transform or combinatory mode which enables any input mode serial order statement to be synthesised by the machine 4) a convergent control and "choosing" mode, which computes control functions analogous to vectors or collinear points in projective geometry on higher language spaces. It is necessary to realise that the data structures generated within the system are not "codes" for the inputs in the usual sense but descriptions of the set structures that have appeared at the input in terms of transformations of machine states. Thus one uses the machine languages to describe, identify, locate or "choose" or generate data structures, which are stored elsewhere in the system. The best way to visualise the system is as a network of interlaced decision trees, divergent in the combinatory and convergent in the "choice" and control modes, distributed across the transfinite phase space. The current model has three levels of input language and four levels of transfinite metalanguage. If one could compute strings the length of DNA in the genetic code, the capacity of the system would be several times larger than the genetic code-protein synthesis system of the body, with which it may have affinities.

Work is progressing on a brain model with several levels of short and long term memory, a cybernetics of quasi-non-deterministic systems, and an information describing computer, based on the concepts we have outlined. A preliminary paper on the mathematical aspects of the work will be ready by the end of the year.

Before concluding I would like to say something about the computer and the arts. What I have said earlier on about the limitations of existing machines, applies even more to their potential use in the arts, since the arts are par excellence the highest expression of the brain's quasi-non-deterministic activity. I have an uncomfortable feeling that a great deal of existing computer art is a rather sophisticated kind of painting by numbers. I am also rather suspicious of the use of randomising, as distinct from pseudorandomising which is the selective controlled use of structured binary sequences with a distinct and very interesting mathematical identity which may well be significant in natural quasi-non-deterministic systems. In music, I feel that tremendous things are happening, but I think that these are much more due to an increase in the intuitive awareness of the subtlety of non-linear time series, to which computer and electronic composition have contributed, rather than the direct use of these devices per se.

Although this article has been concerned with the almost impossible task of explaining a very complex and difficult piece of work in general terms, I hope some of the breadth of my practical and philosophical interest has come

through. If any readers are interested in this area of research or would like to take cudgels with me, I hope they will get in touch.

References:

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- 3 COHEN P J "Set Theory and the Continuum Hypothesis" W A Benjamin N Y 1966.
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ibid.
- BRIGGS P A N

'It is a fallacy to think that innovative activity today only takes place in well-equipped laboratories with highly salaried staffs. The computer industry, whilst affecting to be radical, is in fact integrated with the heart of an economy based on waste and mis-management of resources. One can imagine the difficulties of an isolated individual with brilliant insights based on practical computing devices; neuro-cybernetics; automata theory and set theory, that few people understand or are prepared to consider.' This is the comment of a member of the Computer Arts Society, who knows Hyde and his work well, and who points out that Hyde has worked in the area of Cybernetics since the end of the last war.

Gordon Hyde and the Computer Arts Society first met up at the first manifestation of the Society—EVENT ONE, at the Royal College of Art, London March 1969. The effect was instantaneous. Hyde quite simply presented himself to those people whose work he considered particularly interesting, and told them all about his own far-fetched, but obviously significant work. Meetings followed, and in a matter of weeks, an inner circle of Computer Arts Society members was formed whose password was HYDE. But there was not only talk. In May, the Zagreb Manifesto, of which Hyde is a co-signator, was presented to the Zagreb Computers and Visual Research Symposium, and printed in the June issue of Studio International. Jonathan Bentall, a member of the circle, started to mention Hyde's ideas in his monthly Art and Technology page in Studio International. Unfortunately, Hyde's departure that summer to rural isolation made contact more difficult. In the meantime, Hyde continued to pour out massive and highly technical papers detailing the results of his research into the construction of a revolutionary kind of computer.

Apart from the fact that Hyde's young wife is an artist, Hyde has many affinities with art. He often works intuitively, and one sometimes wonders if his career is not like that of a highly gifted artist, who sensing the destructive effect that success might have on his work and life, does all he can to evade the risk.

At present, Hyde's original research and his output of writing is in danger of coming to a halt since in recent months he has been obliged to work on highly technical abstracting work (in several languages), in order to maintain his family. It is tragic that a man of such outstanding achievement and potential should be condemned in this period of affluence to summarize the work of others.

The ideal environment for Gordon Hyde would be some position in a University, where he might communicate his ideas to younger people; have that access to the latest publications that the development of his work demands; and exchange ideas with other researchers. I would be glad to hear from anyone with ideas on this, or who would like more information. Hyde is willing to send copies of the bibliography of his own writings. His address is: Gordon Hyde, 11 The Close, Dunmow, Essex.

Gustav Metzger

THIS TIME IT'S FOR REAL. Imagine Playboy (the egghead side); the Bulletin of the Atomic Scientists; Dataweek, and Black Dwarf, amalgamated, and distilled into a few pages. This just about wraps up

REAL TIME. If you are in computers, read it. Display it openly, or read it furtively, depending on circumstances. Best of all, subscribe, ask for it to be sent in a plain envelope, then read it in the security of the home. Subscription: 12s. for six issues (includes postage). **REAL TIME**, 66 Hargreaves Park, London, N19. Tel: 01-272 0093. Copies may be inspected (gloves provided) at Dillons, the computer department, (in the basement).

British Computer Society Specialist Groups. Social Implications. Chairman, D.F. Bailey, 52 Farleigh Road, Blackwell, Bristol. **Computer Privacy.** P. Wyatt, Systems Programming Ltd., 75 Grosvenor Street, London W1. 01-493 9301. A bibliography of 59 items has been produced and is available.

A NEW ANTI-WAR ORGANIZATION IS COMPILING A COMPUTER DATA BANK ON CONGRESSMEN to keep abreast of all the decisions, attitudes and situations prevailing on Capitol Hill about the War in Indochina.

Initial efforts by The Continuing Presence in Washington organization involve the storage of the results of student surveys of congressmen in a GE-635 computer data bank housed in Dartmouth College's Kiewit Computation Center in Hanover, N.H. "We want to develop a clear picture of what each congressman is doing," said Paul Velleman, CPW's EDP co-ordinator. He said they can do it best through a computer data bank.

From: Software Digest' 9 June 1970, page 5.

The ICA is dedicated to the very laudable task of bridging the gap between the arts and the sciences. In this effort, there is a constant danger that the gap will be bridged by the reduction of art to the style of 'objective' science, a sort of 'objective' art which is dedicated to the elimination of all human bias or subjectivity in its composition. The detailed exploration of certain visual effects or the generation of purely random tonal sequences by computers can expand our range of sensitivity; but they can also become deliberate evasions of the central issue: an understanding and representation of our total being, of our experience and knowledge of ourselves and the world. This is the only possible valid goal of art; and it is also the only possible valid goal of science. Both constitute aspects of the creative dialogue, the interaction between the inner and the outer worlds.

Extract from statement by Dr. Brian Goodwin, University of Essex, printed in the ICA eventsheet, London, August, 1970.



NEW AND RECENT PUBLICATIONS

LEONARDO International Journal of the Contemporary Artist is getting more and more in every way. If you cannot see it at a library, an annual subscription is only £2. For full details and brochure write to; Pergamon Press Ltd. Headington Hill Hall, Oxford OX 3 OBW England. (And please mention PAGE.)

International Journal of System Science, editor B. Porter, Salford. This journal, commencing July 1970, is primarily concerned with the publication of papers dealing with the theory and practice of mathematical modelling, simulation, optimization and control, with particular reference to biology, ecology and transport systems. Published by Taylor and Francis Ltd., London. Quarterly, four issues per volume of 400 pages, £10, \$24.50, post free.

Studies in the History and Philosophy of Science, Joint Editors, J.L. Landau, Pittsburgh, Gerd Buchdahl, Cambridge. Published by Macmillan (Journals) Ltd. Quarterly, £5, \$13.50, air mail. Subscription Dept. S/N 7, Brunel Road, Basingstoke, Hampshire, England. The first issue has just appeared.

ARse is the title and stands for Architects for a really Socialist environment—or whatever you want to call us. This is a very tough product, with lots of illustrations and hard facts. Now in its third issue, it is a required addition to any serious library in this field. Subscriptions 6s. (4 issues). For another 10s. you become a 'supporter' and will thus help build a better information service, and will be kept in touch in various ways. From ARse, 20 Chalcot Road, London N.W.1. Tel. 01-586 0554.

Social Policy, a new magazine devoted to today's major problems, is being published by the International Arts and Science Press Inc. 901 N. Broadway, White Plains, New York 10603. U.S.A. According to its Editor D. Frank Riessman, the magazine 'will deal with the politics of the human services—education, welfare rights, etc'. The editorial board includes Noam Chomsky. Appears six times a year. Subscriptions \$8.00.

One of the most relaxing publications appearing in Britain is the Arts Labs Newsletter. A monthly, its striking covers will assure it of Collector's Status. The July issue has the image of a bearded young patriarch surrounded by four ladies dressed in garters and chokers. Subscription: 18s. a year from BIT Information Service, 141 Westbourne Park Road, London, W.11.

SOME ARTICLES AND JOURNALS OF PARTICULAR INTEREST

Scientific American, June 1970. Ivan E Sutherland, Computer Displays. Illustrated. This is a knockout article by a master.

Art Direction Enters New Age as LIFE begins Layout by Machine. Publishers Weekly, 6 July, 1970, pp 28–29. See also article on Photocomp system in same issue.

Science Dimensions. National Research Council of Canada, June, 1970. 'The Headless Musician'. Article discusses use of computers to produce music by the Radio and Electric Engineering Division at NRC. Professor-Composer Nil Parent at Laval University School of Music is using computer for research on the theoretical aspects of musical composition.

Science Journal, June, 1970, p. 14. With the aid of a computer, a group of American scientists have made a film which shows the birth of a galaxy. Covers 2,000 years in ten minutes. Film is black and white, silent.

Physics Today, July, 1970. A special issue: Digital Computers in Physics Research. This is the first of a series on new developments in computers and their use by physicists.

SIAM Review. Vol. 12, 1970. A supplement to SIAM Review. Graph Theory in the Soviet Union. Extensive bibliography.

Studies in Applied Mathematics, June, 1970. Stephen Grossberg: Some Networks that can Learn, Remember and Reproduce any Number of Complicated Space-Time Patterns.

Dr.-Ing. G. Gliemeroth: Phototrope Glaser als Computerspeicher. Umschau in Wissenschaft und Technik, Heft 7, 1970.

PICTURES FROM SOFTWARE

A report on SOFTWARE appeared in the last issue of PAGE. The report gave a biased insight into the show as the article had to be cut at the last minute due to space difficulties. Apart from its emphasis on the computer, SOFTWARE is also a most sophisticated showcase for Conceptual Art. The picture we show presents the poet John Giorno 'formerly known as John Giorno' but now labelled 'Giorno Poetry Systems', testing his equipment for Radio Free Poetry, his contribution to the exhibition. The other picture shows one of the forty fury gerbils in the exhibit mounted by the Architecture and Machine Group at MIT. For details on this and other exhibits see the August issue of PAGE. The show continues at the Jewish Museum, 1109 Fifth Avenue, New York till 8 November, when it transfers to the Smithsonian Institute, Washington D.C. where it can be seen from 16 December till 14 February, 1971.

THE ART WORLD ERUPTS

Remember EARTH DAY 22 April, 1970? The art world is about to experience an analogous action. A small cadre of dedicated revolutionary artists from Britain, America and other countries, held a meeting in Amsterdam towards the end of the summer. They formed a loose organisation with the memorable title—INTERNATIONAL COALITION FOR THE LIQUIDATION OF ART. A call was issued for artists in all parts of the world to gather on 20 OCTOBER 1970 and demonstrate their opposition to the commercialisation of art, and other evils in society. Here are extracts from the manifesto:

INTERNATIONAL COALITION FOR THE LIQUIDATION OF ART

Art today is a monopoly among many others./Art today is a monopoly of creativity./Art today is a monopoly of knowledge/Art museums are the banks of the art world./Art auction houses are the stock exchange of art./Art magazines are the ticker tape./Art galleries are its show rooms./Art works are commodities./Artists are the creators of commodities.

Art today is the end of the road./It is a result./It is a static thing./The final result (and we really mean final) of creativity today is art pollution.

ALL ARTISTS WILLING TO PROSTITUTE THEIR FUNCTIONS IN THIS WAY—

ALL ARTISTS WHO USE THE TITLE OF AVANT-GARDE TO HELP CONSERVE THE OLD ELITE—

ALL ARTISTS WHO REFUSE TO JOIN IN ATTACKING THE PRESENT SYSTEM— ARE SHIT.

THERE IS ONLY ONE SOLUTION.

WE MUST LIQUIDATE THIS CRAZY THING CALLED ART TO MAKE IT POSSIBLE FOR ALL PEOPLE EVERYWHERE TO BE CREATIVE.

IT IS OUR DUTY AS ARTISTS TO BECOME SELF-DESTRUCTIVE IN A CONSTRUCTIVE WAY.

WE MUST LIQUIDATE NOT ONLY OUR OWN FUNCTION AS ARTISTS BUT WE MUST LIQUIDATE THE ART SYSTEM AS WELL.

The artist must liquidate the art world by demonstrating at museums, galleries, and auction houses until they close down their doors./The artist must liquidate the art world by closing down art magazines, art councils, and art foundations because they are the tools of an irrelevant society.

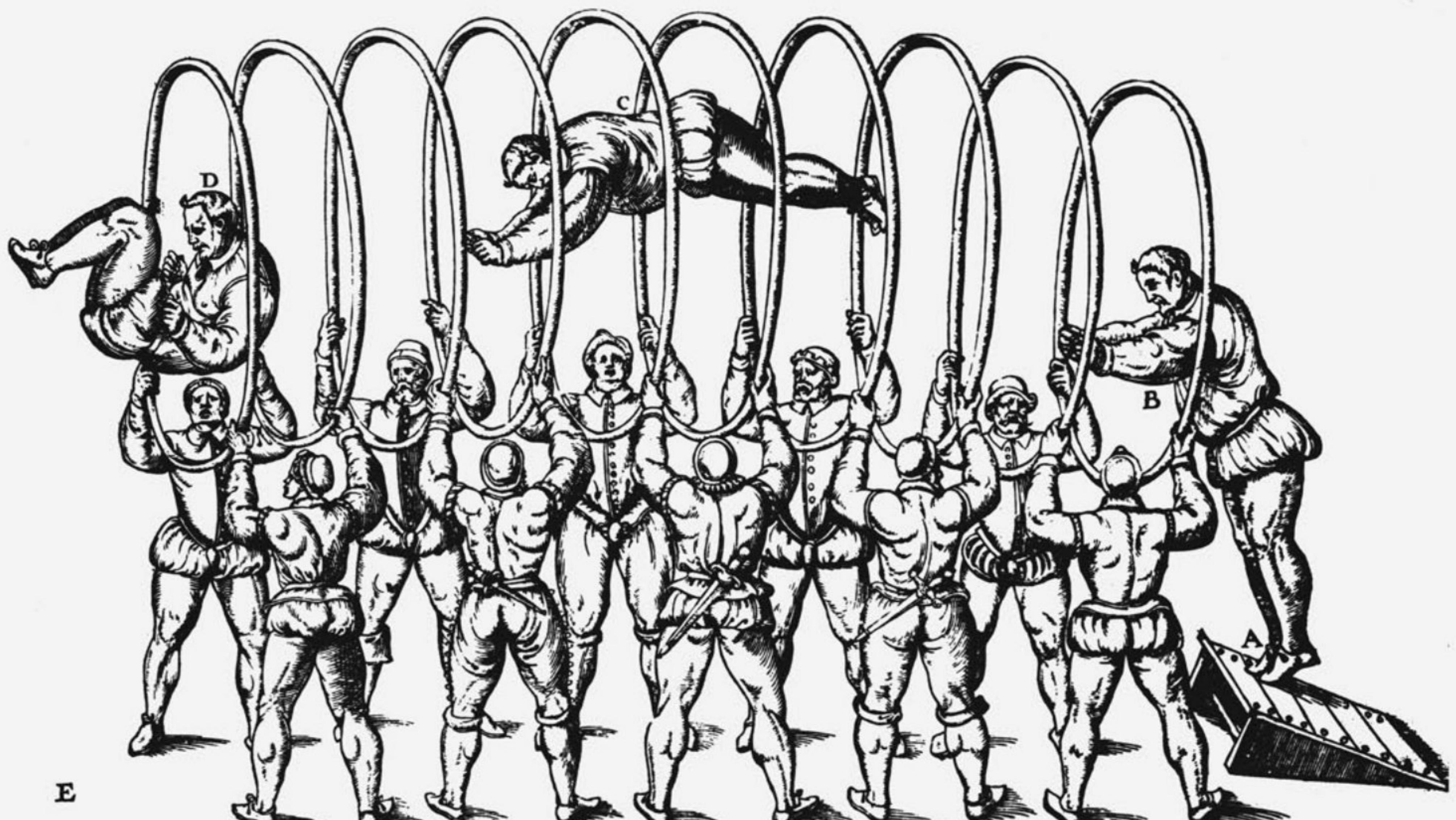
ALL ARTISTS WHO CONTINUE TO WORK WITH THE SYSTEM WILL BE REQUIRED TO PRODUCE NOTHING BUT MINIATURES IN ORDER TO LIMIT THE GROWING ART POLLUTION. THOSE WHO DESIRE MAY ALSO BE PERMITTED TO MAKE ARTISTIC PAINTING ON BOMBS BEFORE THEY ARE DROPPED ON PEOPLE.

On the theme: Threats and Promises of Science, LASITOC International held its workshop at Imperial College, London in July. There was plenty of action as the young people from many countries went on with their work. LASITOC—Look at; Search in; Try out Committee, is concerned with integrative studies of alternative futures. Plenty of documents emerged from the duplicators as the various groups produced their reports. These are people worth keeping in touch with. LASITOC Swedish Centre, Jan Fjellander, Astreavagen 5, S-181 31 Lidingo 1. Sweden. Tel: Stockholm 08/775 05 73. LASITOC British Centre, Peter Harper, Laboratory of Experimental Psychology, University of Sussex, Brighton, England. Tel: Brighton 0273/66755 ext. 55-56.

Groep Integratie is a Centre for Interdisciplinary Socio-Technological Research. It consists of young people from the fields of engineering, architecture, sociology, linguistics, philosophy, criminology, public relations and communications, music, dance and poetry. They have an ambitious programme. Info-Centre Groep Integratie c/o Anneke den Heyer, Naamse Straat, 108, 3000 Leuven, Belgium. Tel: 016/20580.

'The Next Fifty Years' a 32-part television report on environmental control during the coming half-century has been produced by Visual Information Systems (15 Columbus Circle, New York 10023). The series features 60 authorities from all disciplines, among them Rene Dubos, Herman Kahn, Charles Abrams and B. Fuller. Each of the 32 programmes has a running time of 25 minutes and each deals with a basic issue of urban crisis and environmental control. The series is designed for use by colleges, civic and business groups.

CAP. Computer/architecture programs. How can the computer help architects? What computer programs are now available for architectural application? Where are they now being used? (Go on.) How can the architect get hold of them? What equipment is available to meet the particular needs of an architect? Would you believe it? These questions are answered in the 3 volume set of the 'Computer/Architecture Programs Reference Manual. Over 120 (one hundred and twenty) computer program abstracts are documented, illustrated and categorized according to their functions in the architectural process.' Price in U.S. inclusive of post \$28.00. From: Center For Environmental Research, 955 Park Square Building, Boston, Massachusetts 02116, U.S.A.



BACKGROUND TO COMPUTER ART NO. 4

Illustration from Tuccaro (Archange) 'Trois Dialogues de l'Exercice de Sauter, et voltiger en l'air'. Paris, 1959. Photo courtesy of Sotheby & Co. London.

THE ENVIRONMENTAL CRISIS AND THE ARTIST

Artists gathered in Italy in September to make works in protest at the pollution of one of Italy's loveliest rivers. The action was led by Bruno Munari of Milan, one of the most intelligent and influential artists in the country.

In America an organisation called 'Artists Against Ecological Suicide' has recently been formed. Their first action is based on using blank canvases with sticky resin which are to be exposed to the 'normal' atmosphere in seven major cities. The 'works' will then be sold to fight environmental degradation. Contact is Cori Randle, 162-31 Ninth Avenue, Whitestone New York, U.S.A.

In Britain, the British Society for Social Responsibility in Science, has formed an Art and Technology group. Among other plans, the group intends to mount a series of graphic demonstrations of environmental problems, such as pollution, the recycling of waste products and the potential harmful effects of widely used products. The aim is to bring these issues widely before the public. Anyone with ideas on the subject, or skill and talent which might be useful is asked to make contact.' The Secretary of BSSRS is David Dixon, 70, Great Russell Street, London, WC1. 01-242 8535.

The group was connected with the BSSRS demonstration at the annual meeting of the British Association, in Durham last month. The first demonstration sponsored by the group coincided with the opening of the Arts Council's international KINETICS exhibition 24 September, (at the Hayward Gallery, London till 22 November, 1970). The work MOBBILE was presented to critics and spectators

and driven around London. It consists of a box covered with PVC, and mounted on top of a car. The box contained meat, flowers and vegetables. A tube fed the exhaust of the car into the box, with stunning visual (and chemical) results. The group hopes that the idea will be taken up by people around the world. A 'Multiple' with a difference:

SOUTH AMERICA

CAYC.—Centre of studies in Art and Communication. Foundation of Interdisciplinary Research. Elpidio Gonzalez 4070 67-8046/7774 Buenos Aires, Argentina.

Intensive Seminars 1970.

Organized by the CAYC and by the Gallery Bonino.

First Seminar:	Art and Social Structure	25th July
Second Seminar:	Art and Industry	29th August
Third Seminar:	Art and the psychological process	26th Sept.
Fourth Seminar:	Art and Architecture	31st Oct.
Fifth Seminar:	Art and Science	28th Nov.

Meetings take place from 4-8 p.m.

The participants will be a multidisciplinary group formed by speakers and disputants. A questionnaire will be discussed by artists, critics, psychologists, sociologists, anthropologists, epistemologists, architects and industrialists. Each speaker will state his ideas for 15 minutes and then the group will discuss them giving arguments in support of or against them.

- 1) ART AND SOCIAL STRUCTURE. Co-ordinator: Gregorio Klimovsky
- What are the artistic languages of the 70's?
 - Is the artist an element of social change?
 - Are there any artistic expressions independent of an ideology? (form and aesthetic content, form and ideological content).
 - Is it possible to talk about artistic expression in a situation or process of change?
- 2) ART AND INDUSTRY. Co-ordinator: Jorge Glusberg.
- Which are the points of contact between the industrial way of thinking and the "oeuvre d'art"?
 - At which levels do art, technology, design and mass production interact?
 - Do you believe in the possibility of a mass produced "oeuvre d'art"?
 - Is it possible for an artist to work as a professional in an industrial enterprise without losing his autonomy?
- 3) ART AND THE PSYCHOLOGICAL PROCESS. Co-ordinator: Fernando Ulloa.
- Art as a clustering system of communication.
 - The attitude of psychologists to the creative faculty and to social change.
 - Is there any place for the psychologist among artists? His role.
 - Review of the concepts of health and sickness in relation to the various contemporary artistic languages.

- 4) ART AND ARCHITECTURE. Co-ordinator: Carlos A. Mendez Mosquera.
- Do you think that Architecture in itself is a form of artistic expression?
 - Do you think there exists a correlation between the language of contemporary art and today's architecture?
 - In what way do you see artists and architects working together in the common task of shaping the every-day environment?
 - Which factors from the development of industry, from new policies, and from social change, do you foresee having an influence on the greater integration of art and architecture?
- 5) ART AND SCIENCE. Co-ordinator: Manuel Sadosky
- Is the gap between artists and scientists decreasing or increasing?
 - Which scientific knowledge should the artists have, and which artistic knowledge should the scientists have?
 - Which scientific knowledge could the artist apply to his work at present?
 - Which techniques are most related to artistic activity?

Panel for the First Seminar, Art and Social Structure: Martha Berlin (psychologist), Ernesto Deira (artist), Jaime Kogan (theatre director), Osvaldo Kreimer (sociologist), Lea Lublin (artist), Eduardo Menendez (anthropologist), Felipe Noe (artist), Margarita Paksa (artist), Juan Pablo Renzi (artist), Marta Slemenson (sociologist), Guillermo Whitelow (art critic).
Co-ordinator: Gregorio Klimovsky (epistemologist).

Gallery Bonino Marcelo T. De Alvear 636 Admission FREE.

