TWO CULTURES: A DANGEROUS GAP

Not too many years ago, C. P. Snow wrote his celebrated essay on The Two Cultures. Snow, who has credentials both as a novelist and a scientist, called attention to the fact that the educational process in the Western World tended to produce an opposition between the literary and the scientific traditions, with a gap between them which was virtually unbridgeable in an intellectual sense. On either side, there was at best disinterest in the other; at worst, contempt.

It seems, unfortunately, that the Two Cultures problem is with us again, although not in the form that Snow visualized it. This time it exists between the scientific community on one side and The Congress and the Executive Branch of the Government on the other. What makes the situation disquieting is that government, by its very nature, is as sensitive as litmus paper to the mood of the general populace. Accordingly, it may be inferred that behind the attitude of the government there lies, however inchoate, the attitude of the people.

The evidence for this gap consists of a number of things. As the February 1974 issue of The Washingtonian magazine points out, “In early 1973 President Nixon, with the blessing of Congress, bashed the wrecking ball against the White House science structure. Eliminated from the President’s staff were the Science Adviser to the President and two groups chaired by him: the Office of Science and Technology (OST) and the President’s Science Advisory Committee (PSAC). Scientists could rationalize their fall from public grace, could even empathize with their detractors. They could live with the ferment and militancy within their own ranks, even ultimately benefit from this exercise in self-criticism. But the upheaval at 1600 Pennsylvania Avenue left them dismayed, apprehensive, and confused.” In evaluating this situation, the magazine asked: “Did the White House’s dismantling of its scientific apparatus signal a Nixon Administration downgrading of science at a time when the nation has problems only science can solve?”

Another indicator of the times is section 203 of the 1970 DOD authorization (“The Mansfield Amendment”). This required the military, in the words of the magazine, “to abandon all basic research not linked
FROM THE DESK OF THE PRESIDENT

ROY HERRMANN

The term "cybernetics" has been surfacing more and more in discussions and in literature, a clear indication that this new science is beginning to be considered for a more sophisticated approach to decision making in complex systems. ASC has now clearly a mandate to develop a free flow of ideas about cybernetics and to provide an outlet for discussion on controversial matters. The objective, of course, is to broaden the market coverage.

We are now in a position to announce plans which have been in the development stage for some time to promote the ASC FORUM through closer ties to other groups in related areas. The American Society for Cybernetics and the American Society for Information Science have in a number of conferences agreed to use the ASC FORUM for distribution to members and friends of the two societies. We are more than happy to know that this will lead to a widening of our sphere of influence. The increase in the number of copies to be distributed should ultimately result in improved services and high-quality contributions.

We are hopeful that the ASC FORUM will be in demand and widely read by cyberneticians within academia, in government agencies and research institutions to focus attention on pertinent and timely issues and on activities which are being pursued in form of important and significant research projects, where these disclosures can be made without violating any proprietary information, and to develop a dialogue on controversial matters as a basis for innovative developments. The ASC FORUM will hopefully provide the framework for discussing issues in information, communications and control emphasizing the need for self regulation in complex systems.

Your assistance is invited to provide worthwhile contributions which will be reviewed and evaluated for acceptance.

STATEMENT OF EDITORIAL POLICY

The ASC FORUM is an internationally distributed quarterly publication of the American Society for Cybernetics. It is published to promote the understanding and advancement of cybernetics. It is recognized that cybernetics covers a very broad spectrum, ranging from formalized theory through experimental and technological development to practical applications. The boundaries of acceptable subject matter are intentionally not sharply delineated. Rather it is hoped that the flexible policy of this publication will not only follow, but promote, the evolution of cybernetic thought.

Priority in publication will be given to scholarly papers on subjects of broadest interest that combine originality of thought with soundness of presentation. Tutorial or review papers on subjects of current or historical interest are welcome.

All papers will be submitted to at least two referees, who in the opinion of the Editor are authorities in the appropriate field. Names of referees may be suggested by the author. Acceptable papers will be published, provided suggested revisions of the referees are complied with. The final determination of the acceptability of a manuscript will be made by the Editor. The ASC FORUM normally will not publish conference digests or symposia proceedings. Manuscripts copyrighted, published, or submitted and accepted for publication elsewhere are not acceptable; published papers will be copyrighted by the American Society for Cybernetics.

Short Communications and Letters To The Editor are encouraged. These may be:

a) Brief reports (500 words or less) which present a new idea or preliminary results; unresolved issues or interesting applications;
b) Relevant comments on issues of interest to "cyberneticians"; and
c) Relevant comments on papers published in the ASC FORUM.

Rebuttal space will be provided for authors to answer criticism of their papers.

Membership in the American Society for Cybernetics is not a prerequisite for the submission and publication of acceptable manuscripts.

INFORMATION FOR AUTHORS

Three copies of manuscripts, including references and abstract (abstract will not be published), should be typewritten, double-spaced, and submitted as original copy (two may be good office-duplicated copies). References must be:

a) for papers: Author, initials followed by last name, title, periodical, volume, inclusive page numbers, month, and year;
b) for books: Author, title, publisher, year, chapter, and page number if desired.

References must be compiled numerically in the order they are first cited in the text. When illustrations are used, at least one of the three complete sets must be glossy, 8 1/2- by 11-inch photographs. A separate sheet listing all figure captions must be provided when illustrations are used.

The complete set of manuscripts should be accompanied by a separate, signed letter, giving the preferred address for correspondence and return of proof. The letter of submission will be considered permission to publish and copyright the manuscript, if accepted.

VOLUNTARY PAGE CHARGES

After a manuscript has been accepted for publication, the author's company or institution will be required to pay a voluntary charge per printed page to cover part of the cost of publication. Page charges for this publication, like those for journals of other professional societies, are not obligatory nor is their payment a prerequisite for publication. The author will receive 100 free reprints without covers if the charge is honored. Detailed instructions will accompany the galley proof.

Mail all manuscripts to: George M. Samaras, Editor, ASC FORUM, Department of Zoology, University of Maryland, College Park, MD 20742.

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Cybernetics, the science of control and communication in the animal and machine, is a fusion of many other disciplines, among them syllogistic and symbolic logic, mathematics, mechanical and electrical engineering, improvements in calculating devices and logical machines. Its history, therefore, has been a combination of development in these fields together with the rising need and financial support for the cybernetic techniques and machines which came about in the 20th century.

The most primitive and earliest computing devices probably are the two-name binary counting systems of Australian tribes, the Peruvian Indians' knotted ropes, and the five number abacus used 5000 years ago by the Chinese, then by the Japanese, Russians, Turks and Armenians.1

Similarly, the Babylonians and Egyptians developed a sophisticated level of reckoning to deal with the problems of building, as evidenced by the Glenischev papyrus, Ahmose the scribe's works (12th dynasty) and the Babylonian quadratic equations (200 B.C.), but the Greeks alone developed abstraction, the idea that general laws could govern the universe.2 From Thales, 590 B.C. and the Pythagoreans, who, respectively, saw water and number relations as the foundation of the universe, to Diophantus innovation of +, - and = signs in 590 A.D., Greek thinkers laid the foundation of logical and mathematical reasoning. Anaxagoras, Eudoxus and Archimedes concerned themselves with the method of exhaustion, which tries all possible combinations and is now a basic computer technique; Zeno of Elia with the infinite, infinitesimal and continuity, Platonists with positive real numbers. Euclid with summing progressions by equal ratios, Archimedes again with generating and expressing large numbers, and Pappas with the calculus of variations, but the height of Greek logical thinking came with Aristotle, who invented the syllogism, a technique perfected by his disciple, Theophrastus with his modal propositions, which later became an indispensable part of computer programming.

Fundamental as the Greeks' philosophical contributions were, their passion for abstraction at the expense of practical empirical observations also proved to be the barrier, both to creating modern science and calculating machines, neither of which developed until the Baconian revolution of the 17th century.

Because so much of the intellectual milieu of the Middle Ages and Renaissance involved the preservation, systematization, and rediscovery of Greek thought, these periods similarly held few developments important in the technology of calculating devices. The one bright exception was the work of Ramon Lull,4,5 diplomat, courtier, religious mystic (1232-1315). Lull's idea that for every branch of knowledge a small number of categories must be accepted without question, and that by establishing all possible combinations of these, all knowledge could be explored, is similar to the logical principles programmed into the computer whereby all possible combinations are tried. Lull's theory also influenced Leibniz, who saw in it a universal algebra which might bring all knowledge into one deductive system.

Furthermore, Lull did not limit himself to theorizing but went on to invent the first logic machine; a mechanical device used to discover non-mathematical truths.

Aristotelianism declined by the 17th century, when scholars spurred on by a religious desire to elucidate God's order and design in the universe, and a commitment to use the Baconian inductive method of making generalizations empirically from observing particular facts, produced a scientific revolution that also encompassed solving practical problems. John Napier6 embodies both trends, through his discovery of logarithms, and recognition of the abstract importance of the binary scale, and also by his invention of Napier's bones, a mechanical device of strips, which when placed in proper combination could perform multiplication.

From this tradition, also, came Blaise Pascal, known for the theory of intuition, for works on projective geometry, probability theory, and the binomial expansion, the physicist who established hydrodynamics, the existence of vacuum, and the law of equal pressures, yet also the first successful inventor of a calculating machine.7 His "Pascaline", invented to compute tax assessments arranged digits in a number of wheels, each of which made one revolution, thereby shifting its neighbor, 1/10th turn. Although a scientific success, it was a financial failure, for the men it displaced were cheaper than the device, itself.

Leibniz was another 17th century giant, who combined major changes in philosophy and mathematics with meeting practical needs. The father of rationalism, founder of the integral and differential calculus, and formulator of a universal language of logic, was the symbolic logic of Boole, Schroeder, Whitehead and Russell.8 He also invented the first general calculating device for mathematicians and bookkeepers, by improving Pascal's machine with the addition of a steeped-up cylinder to represent the digits from 1 to 9.9

Leibniz's and Newton's ideas, which revolutionized the 17th century, continued to dominate and codify intellectual thought in the 18th. Although Bernoulli10 worked on imaginary and negative numbers, Cauchy on the theory of groups, Lagrange, the calculus of variations, and Fourier, the analysis of curves, the most prominent obstacle to the development of logical, and thereby computing machines, was an adequate system of symbolic notation. Leonard Euler's method of introducing circles to represent class propositions were an exception. They showed class statements and syllogisms in a highly isomorphic manner, and this manipulation of class logic is still used extensively in circuit configuration.

Two significant 18th century technological advances were Charles Mahon's use of gear wheels in his calculating machines for addition/subtraction and multiplication/division,11 which later inspired Charles Babbage, and the Jacquard punched paste-board cards to make designs in cloth, an idea used both by Charles Babbage in his analytical engine and Hollerith in his 1890 electric tabulator.12

The 19th century ushered in the era which develops the methods and means to develop cybernetics as a science in the following century. Great advances are made in symbolic and algebraic logic, as well as in logical machines, themselves, and improvements in calculators are so successful that they in turn fund the financial empires which support the technological improvements leading to the 20th century computer.

The best representative of this remarkable era was Charles Babbage, father of the modern computer,13,14,15 In 1822 he presented his paper "Observations on the application of machinery to the computation of mathematical tables", to the Royal Society, winning their first gold medal and 1500 £; from Parliament to construct the device.16 Babbage never completed his machine, because he lost his engineer after 8 years; and the novel brass, steel and clockwork needed to finish it was not available in his day.17

A successful engine of 4 differences and 14 places of figures to print mortality tables was constructed by Giese Schuetz in 1855 and another by George Grant consisting of a calculating part, and printing unit, containing 15000 parts, which used gears, and weighed over 2000 lbs., was exhibited at the 1876 U.S. centennial exhibition.18

While working on the difference engine, which completed tables according to a certain rule, Babbage planned another engine that computed tables through variable rules and could be programmed to desired

THE CYBERNETIC PAST—AND QUESTIONS FOR THE FUTURE

by Sylvia Dost
D.C. Public Library
results. Babbage's analytical engine consisted of 4 parts: 22 punched cards on which were included the sequence of operations or program; a store which contained the variables and constants; a mill which performed calculations on the variables as they were received from the store and returned, with a series of gears and levers that transferred numbers back and forth between the store and the mill; finally a device for moving the numerical information in and out. His machine, called the mechanical forerunner of the electronic digital computer, because it went beyond counting to combine the processes of arithmetic and logic, was too slow to match the latter. Because the long train of gears it contained required considerable power to run, so that the remaining power and torque became too small to actuate the other parts of the apparatus. 21 Similarly the mechanical energy it used was no match for the high energy levels of the vacuum tube in the first computers.

Vannevar Bush's differential analyzer of the 1930's finally solved both problems, by inserting mechanical amplifiers between stages of the computing machine and eventually adopting the vacuum tube among its components. 22

Although Babbage failed to realize his dream because technology had not yet developed an efficient energy source for it, Herman Hollerith, another 19th century pioneer, met with instant success for his electrical tabulator, used in the 1890 and 1900 census. 23 Adopting the Jacquard pasteboard cards he developed punched cards which contained holes for the tabulating machine, which then counted the holes through electrical contacts, but Hollerith's insistence on renting, rather than selling his machines to the Census Bureau, led them to develop their own equipment for the 1910 census. His successor there, James Powers worked on the mechanical end of the invention, automatically printing results rather than handposting them, using an electric instead of hand punch, and an electric instead of vertical sorter. Hollerith, in contrast, failed to patent the mechanical end of his machine, but his use of the fast inexpensive energy source, electricity, was as much an innovation as the punched cards for which he is better known. Ironically, Hollerith's and Power's rivalry continues today, since their firms eventually became IBM and Sperry-Rand, competitors in the computer field.

The second major 19th century advance was in laying the foundation of symbolic logic through Boole and De Morgan's work on the algebra of logic. Jevon's, Pierce's and Schroeder's writings on the algebra of classes, Peano's increase of the range of symbolic logic and the Venn modification of Euler's diagrams. 24 Jevon also produced a logic machine which solved a complicated problem faster than a manual solution. Charles Stanhope's demonstrator solved both numerical and traditional syllogisms, and the plan for Allan Marquand's machine of 16 possible combinations of true and false terms represented by 16 rotating pointers also contained the first circuit design for an electrically operated logic machine. 25

The interest into logic machines continued into the early 20th century, with Charles MacCaulay's 4-term machine, Pastore's device in 1903 for translating the structure of syllogistic reasoning into physical movement, culminating in Barack's construction of the first electric logic machine in 1930. 26

Logical theory in the early 20th century also produced such intellectual milestones as Frege's description of propositional calculus in logistic form, Russell and Whitehead's incorporation of mathematics into logistic development, and Kurt Godel's incompleteness theorem, which relates to the question of whether computing machines could be constructed as substitutes for a living mathematical intelligence. 27

During the first three decades of the twentieth century there were also suggestions of the analogy between network theory and propositional calculus by such scientists as Erenfest, 1910, V. I. Sestokov (1934-1935) 28 and Nakashima and Masao, 1936, but it was not until Claude Shannon's thesis "A Symbolic Analysis of Relay and Switching Circuits" that the calculus for manipulating the mathematical equations which expressed these circuits was shown to be isomorphic with the propositional calculus of symbolic logic. Shannon's paper laid the foundation for the construction of truth-value logic machines and showed that programming the machine was a problem of formal logic rather than arithmetic. It also replaced the computer's decimal system with the binary system. 29

In 1939, Howard Aiken successfully presented his idea that the logic of all digital machines was alike to IBM, and so a general service computer could be constructed, and together with their best engineering team they produced the Mark I, the first working computer, with a memory, punched paper tape. It could add/subtract in 1/3 second, divide in 16, multiply in 5 and carry a logarithm to 20 places in 1 1/2 minutes. 30 During World War II in an effort to compute ballistic tables faster, Mauchly and Eckert improved on this with their ENIAC which did away with Mark I's telephone relays and electromechanical components and performed the same tasks in 1 millisecond second. 30

The one figure, however, who finally defined cybernetics as a science, popularized it, and thus stands beyond the rest was Norbert Wiener, 31 ex-child prodigy, applied mathematician, unsuccessful biologist and superb electrical engineer. His work generalized harmonic analysis was an outgrowth of his interest in controlling Brownian motion by mathematical means, and he developed said interest to later include reducing the entropy of the universe by control and communication. He similarly recognized the vacuum tube's capability for controlling a large current by a small voltage, recommending its use in Bush's differential analyzer, thereby pinpointing the quick efficient source of power that indeed made the difference between the slower mechanical methods of the 19th century and the high speed 20th century devices.

With World War II cybernetics comes into its own, because it has all the elements for its development and has those interacting. It has a mathematical means for expressing natural phenomena, i.e. circuit theory; an advanced electrical technology, i.e. the vacuum tube that can carry out these commands, quickly, economically, and efficiently; a large pool of research scientists investigating the problem, who similarly have unlimited backing from the industrial and governmental community, and several urgent problems which can best be solved only with its help.

Basically, we have in being at the end of World War II, then, the working model for the computer and the basic pattern for computer science and cybernetics. What follows after this are refinements in the state of the art. Computer technology is improved through stored programs for building in certain components and operations, magnetic tapes in ENIAC and EDVAC, the UNIVAC machines that handled both numbers and descriptive data, Project MAC's time sharing devices, and more advanced circuitry available through the transistor and microcircuits. More important, the scope of cybernetics has been broadened to embrace the idea of Turing's thinking machine, an abstract machine that could be programmed to imitate any other Turing machines, 32 and to investigate communication problems in the biological, medical, psychological and educational fields. But with its coming of age, cybernetics has also inherited its share of problems and some very valid questions about its future, such as the following:

1) Are the uses to which the computer has been put necessarily beneficial to society? i.e. games which determine military strategy.
2) How "micro" a circuitry is it possible to produce to deal with the more complex machines needed in the future?
3) How can computers be designed to meet both needs and purses of individuals rather than the large groups and organizations they now serve?
4) Does Wiener's conception of cybernetics in the Human Use of Human Beings, 33 as the elimination of commonplace tasks in preference to
FURTHER CONSIDERATION OF THE PROBLEMS AND THE NEEDS OF THE CYBERNETIC COMMUNITY

continued from page 1

community on the other needs to be bridged. Not widened. An effort is needed from both sides. The sins of the general public and the government have been abundantly catalogued elsewhere, so they do not require elaboration here. What is required from that side is the urgent recognition that our scientific capability is a major national resource essential to well-being and survival alike. It must be given its due in the councils of state; guided by enlightened, long-range policies; and consistently supported rather than made the plaything of crash programs one year and benign neglect the next.

At the same time, candor compels us to recognize that there is something of a gap between the intellectual maturity and the emotional maturity of some members of the scientific community. It would be helpful for them to pause to consider where their entry into the political game can lead, no matter how shining the cause. This does not mean that they should relinquish their rights as ordinary citizens. Scarcely! But it does mean that they, more than most people, should exercise them carefully, soberly, and responsibly. There is no way to legislate "responsibility." Nevertheless, it is a concept of profound importance to scientists at this juncture of national affairs. Two of its hallmarks are restraint and dignity. In the present context, it means eschewing implications of omniscience and moral certainty in making pronouncements on public issues. Most particularly, perhaps, it means making sure that other people understand when scientists are speaking qui scientists and when they are speaking qua citizens.

There is no doubt that the criticisms which have been made here apply to only a small minority of scientists. However, because it has been an extremely visible and frequently a distinguished minority, it has succeeded in dominating the public consciousness and defining the shape and significance of the term "science" in our mind. Taking steps to repair the damage which has been done would make an important contribution to bridging the gap between scientists and the larger society of which they inextricably are a part. In a free society, it should be the scientists themselves who set high standards of public conduct for their fellow scientists. In their own interest and in the national interest, the time has come for them to do so.

Charles H. Dym
Associate Editor

NOTES

HEINZ VON FORESTER

is conducting a two-semester course in "Cybernetics of Cybernetics" in which about 30 students participate. One of the catalysts of this goal oriented course is the publication "The Cybernetician", of which four issues are available so far.

CANDIDATES FOR 1975

Suggestions of names are invited for the following offices which will have to be filled for 1975:
For one year: President, all vice presidents, treasurer and secretary.
For a three-year term: two directors.

MEMBERSHIP DUES:

A final notice for payment of the 1974 annual membership dues has been mailed on 31 January 1974. It is hoped that those who have not yet sent in their renewal will do so promptly in order to maintain uninterrupted membership.

TAPES OF NOVEMBER 1973 MEETING

Tapes of the November 1973 Meeting on "The Fragmented Society and the Physically Disabled: A Problem of Communication and Control" are now available on request. The price is $25.00 for the package, or $12.00 for a two-side tape, $9.00 for a single side tape.

INTRODUCTION TO CYBERNETICS;

An Existing Course

American University is conducting for the first time two classes of graduate study in cybernetics entitled Introduction to Cybernetics. Both classes are taught by Milton W. Buffington, Colonel, USA (Ret.), Professor at American University.

The course is part of the required curricula for Graduate Level Programs at the Center for Technology and Administration. Eighteen students are enrolled in the course taught on the AU Campus, and eleven are registered for the course taught in Alexandria, VA.

The course syllabus covers organization, system stability and pattern recognition, command and control. Network analysis, information storage and retrieval and the use of cybernetics in management are also topics of discussion.
ASC DIRECTORS AND OFFICERS

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Studies for the CHARLES science, chairman, The Institute of Management Sciences. B.S., Germany; senior staff engineer, Economics, University of Rostock, Germany. College Francais, Berlin; Doctor of Department, Franklin Institute, Philadelphia, PA. Ph.D. in mathematical statistics, University of Munich, Germany. President of ASC, 1970, 1971.

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President of Center of Cybernetic and Interdisciplinary Research, Inc., and of Institute for Socio-Economic Studies, Ltd., Washington, DC; formerly, professor of management sciences and operations research, The George Washington University; professor, naval science, U. S. Naval Academy, Annapolis, MD; chairman, College on Logistics, a Subdivision of The Institute of Management Sciences. B.S., College Francais, Berlin; Doctor of Political Science and Economics, University of Rostock, Germany. ASC President, 1972, 1973.

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Officers

GARY D. BEARDEN, Vice President (Administration) Director, Bureau of Manpower Information Systems, U.S. Civil Service Commission; formerly, assistant bureau director, Bureau of Data Processing, Social Security Administration; director, Washington Data Processing Department of Agriculture; consultant, speaker and instructor, Master's degree, Texas A & M University.

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CARLIS A. TAYLOR, Secretary

Systems: Analyst for the Information and Services Division, Economic Development Administration, U.S. Department of Commerce; formerly, work in the field of modeling and simulations in the intelligence community and civil government; did biomedical research for the Navy and managed the statistical laboratory at the University of Florida as well as the computer divisions of that university, the Naval School of Aviation Medicine, the Armed Forces Radiobiological Research Institute and the National Naval Medical Center. B.A. and M.A. in sociology, public administration and statistics. 1973 ASC vice president (Administration).

CONFERENCE CALENDAR

3-5 April 1974
1974 ANNUAL MEETING of the American Society for Artificial Internal Organs, Palmer House Hotel, Chicago IL. Exhibits will be open for the three days of the meeting and an award will be given for the best scientific exhibit.

16-19 April 1974
SECOND EUROPEAN MEETING ON CYBERNETICS AND SYSTEMS RESEARCH, Austrian Society for Cybernetic Studies, Vienna, Austria.

3-6 September 1974
EUROPEAN MEETING of the Econometric Society, Grenoble, France. Papers to be submitted by 31 March 1974, to Professor A. B. Atkinson, Department of Economics, University of Essex, Wivenhoe Park, Colchester (Essex), England.

13-17 October 1974
37th ANNUAL MEETING of the American Society for Information Science (ASIS) on Information Utilities. Regency Hyatt House, Atlanta, GA. Contacts: Dr. V. Slamecka, School of Information and Computer Science, Georgia Institute of Technology, Atlanta, GA 30332, or Robert MacIver, Jr., ASIS National Office, 1155 Sixteenth Street, NW, Suite 210, Washington, DC 20036.

16-18 October 1974
JOINT NATIONAL MEETING, Operations Research Society of America and The Institute of Management Sciences, on urban, environmental and energy problems, San Juan, Puerto Rico. General Chairman: Armando Riesco, P.O. Box 234, Mayaguez, Puerto Rico 00708. Abstracts of papers must be received by 29 March 1974.
In this light, control and communications appear to be manifestations of order. Communications provide control. Communications are the dynamics of order. Like cybernetics, quality control considers communications as the prime dynamics of response. Measurement of response is important. Process capability can be determined by measuring response against time. Quality costs can be accurately forecast using input-output analyses. Measurement of systems behavior is important. The whole area has the possibility of developing into a sub-science, behavioral cybernetics, as indicated by Vovodsky.

It also appears that structure of the system is an important factor in achieving control. Wiener, Ashby and Pask claimed that the structure affected the performance of the system. Even Wiener's equation for an ideal system indicates that the structure will play a dominant role in determining behavior. It has been my experience that the spatial and temporal relationships of functional elements influence the quality of response. Control (order) is difficult to achieve if the operations are not performed in the proper sequence at the proper time by the proper components. In our technology, quality is an index of the structural and functional order of both the product and the system that produced it. A common axiom is that the quality of the product is symptomatic of the quality (order) of the process. This area could be developed as a sub-science.

The technology of quality control, while it developed independently of cybernetics, incorporates the above concepts. Like cybernetics it, too, is growing and developing new horizons. There are several thousand professionals using this technology to control the quality of manufactured products. It is also an important factor in national economic policy.

Basically quality control is composed of three disciplines: systems administration, control engineering, and assurance engineering. These disciplines are known by several names. Regardless, they utilize principles of cybernetics. Systems administration provides fourth order control to the other disciplines. Control engineering furnishes third order control by producing system control programs. Assurance engineering supplies second order control to manufacturing, procurement, and customer service components. Order is being synthesized at all levels.

Because of my many years in quality control I feel strongly that cybernetics is the science of order and quality control is the technology of order. They are the antitheses of Murphy's Law; "if anything can go wrong it will"—if you don't control it.

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WASHINGTON D.C. CHAPTER
Viewpoints on Cybernetic Definition

Bonnie W. Dunning

The Washington, D.C. Chapter of the American Society for Cybernetics held a series of working group luncheons at The Brookings Institution in 1972 devoted to the discussion of the varied meanings and areas of application of the subject we call cybernetics.

Chapter membership represents a variety of disciplines and the initial definitions stressed the perspective of the chapter membership. In an attempt to reach a consensus definition of the term cybernetics, each member submitted his definition after discussion of basic concepts and similar portions of each definition were compared. From this comparison we saw that complex, dynamic systems containing information and command and control descriptors are part of the science of cybernetics. Several factors introduced variety into the definitions. One breakpoint was the distinction between the theoretician and the technologist. The range and scope of the definitions reflected either a generalized philosophical "Weltanschauung" or an applications-oriented approach using more specialized terms.

Another problem was that cybernetics as a multi-disciplined science must cope with the linguistics and specialized terms of each discipline. A third reflected individual concerns over the distinction between systems analysis applications and cybernetic applications. The use of the term feedback to restrict cybernetic system applications was often invoked.

Interchangeable meaning for significant words also confused the attempt to reach a common definition. Pattern recognition can mean separate things to (1) a scientist developing artificial intelligence applications, (2) a biologist performing cancer research, (3) an economist analyzing trends and (4) a generalist searching for commonality in information. Each of these endeavors may be founded on cybernetic principles and therefore classified as cybernetic.

One other point of departure was discussed by the Washington, D.C. Chapter. Must cybernetics be in some way associated with man via design or in the feedback loop? Others contended that information and response to information is the basic element with which cybernetics is built.

The discussions in the FORUM may repeat a great deal of what the Washington, D.C. Chapter has discussed, but only through such exchanges can we approach the commonality we need before we can establish a curriculum and a means for training people in the use of the science of cybernetics and cybernetic tools.
THE CYBERNETIC OSTRICH

Charles P. Lecht, President of Advanced Computer Techniques Corporation (ACT), one of ASC’s corporate members, reports on research efforts of his of the effects of automation infusion in corporate environments. In doing so he has issued a warning not unlike those to be found emanating from the Food and Drug Administration relating to the careless distribution of new pharmaceutical products; “the user should be aware that more research is needed to determine the higher order and/or long term effects etc., etc. . . .” Analogously, many corporations, having taken the automation pill in America during the last twenty years have started to experience certain phenomena which were not predictable at the onset and which are causing corporate chaos and boardroom crisis.

Mr. Lecht envisions the act of infusing an automation environment to be in some way similar to a heart transplant, except in rare cases, nothing as dramatic as environmental rejection has occurred although such phenomena are more prevalent in the short term than one might expect. Anyway, time dimensions are relative to the cyclic pulse of the environments within which they occur, and what is deemed to be a long range effect in one environment may be short range in another.

If automation specialists had the means to examine the effects of automation infusion in various well classified corporate environments, where these effects relate to the myriad of factors which determine success or failure trends, catastrophic corporate events, the seeds of which have been sown in the past through the employment of automation technology might be avoided in the future.

Not unlike other observations in life Mr. Lecht feels it is the subtle slow change over time that is hardest to deal with, usually because we are unaccustomed to handling that which we cannot see or, better stated, which our senses cannot perceive. Sociopolitical economists with very sensitive perception are deemed prophets of doom by their less endowed colleagues, such judgements deriving from massive ignorance encouraged by short term economic gains. Thus, cyberneticians find little acceptance in their study of the dynamics of change; the pay-off is too frequently long term. And, creeping change observational abilities, in the hands of socially irresponsible scientists, lead to things like energy crises.

Hardly anyone has addressed the problem of what automation infusion in corporations and government is occasioning. So today we see corporations struggling to maintain their identity, others hiring consultant detectives to find their corporate headquarters and still others experiencing premature stimuli for retirement of sage-like intelligent, well-seasoned, older management.

Computer systems infusion, we all agree, is a requirement to release men from dehumanizing activities and no one who has worked* could really argue with the promise of relief that automation technology offers. At the same time, unless cyberneticians whose ability to grasp heretofore unrelated phenomena but now discovered highly related are encouraged to bring to the public’s attention the higher order and long term effects of automation infusion in the daily fabric of our lives, classic business processes will undergo energy-crisis-like changes the likes of which we can well do without.

A few hardy souls who disdain living ostrich-like lives are to be found in the ranks of cyberneticians, a class of people whom one might say are interested in overriding factors among other things. Crises visited on world population masses over the past years are but a prelude to the epic sagas we may yet experience if we do not take our heads out of the ground. The population of ostriches has now revealed itself to be larger and more diversified in method and purpose than we would like. Time is running out.

*Lecht defines work to mean the need to do what he does not want to do or at a time he does not want to do it, and at a place he does not want to be.

RECOMMENDED READING

Among the central preoccupations of cyberneticians and cybernetics is the problem of the nature of cognition. Subsumed are the issues of instruction, or how knowledge (or capabilities) possessed by one intelligent system can be efficiently and reliably communicated to another. What means are there for feedback/measurement of the reception of transmitted information and, even more importantly, its appropriate organization by the receiving system? How does instruction differ for intelligent systems which are being artificially created “from scratch” as opposed to those which pre-exist as self-organized systems (e.g., human beings)? How may practical use be made of the powerful properties of (formal) algorithms under conditions in which uncertainty precludes uniform prescription of all component operations of the algorithm?

These issues and many more are addressed in the recently published translation from the Russian of L. N. Landa’s “Algorithmization in Learning and Instruction”. Since its original publication, this seminal book has been viewed as a classic by European psychologists and educational scientists, and it has been the stimulus for diverse research studies by educational scientists, psychologists, linguists and others. Presumably the esteem for this work will now be shared by the English speaking world. Undoubtedly this 752-page book will be of major interest to cyberneticians and other system oriented scientists. It is available from Educational Technology Publications, 140 Sylvan Avenue, Englewood Cliffs, NJ, 07632, ($14.95).

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Tuesday Evening, 7 May 1974

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SPEAKER: Roy Herrmann, President, American Society for Cybernetics

(Further details to be announced.)

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Negotiations are underway for ASC and ASIS to publish the ASC FORUM jointly. It is expected that it will grow to 32 pages per issue.

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