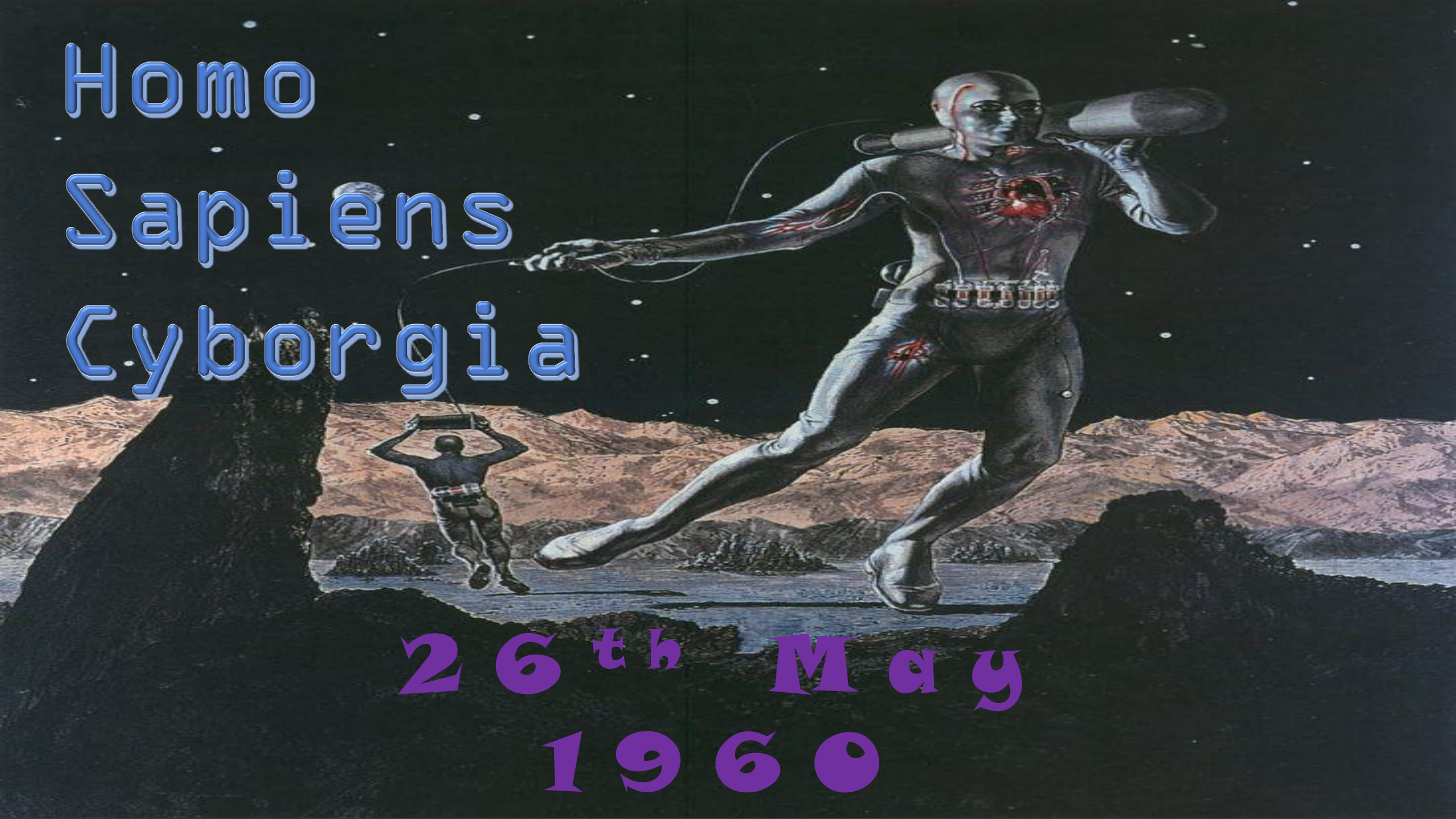

Homo
Sapiens
Cyborgia
26th May
1960

Dr. Nathan Kline
(psychiatrist)

Manfred Clynes
(engineer)

Rockland State
Hospital
New York

The Conference on the Psychophysiological Aspects of Space Flight

School of Aerospace Medicine
Brooks Air Force Base
26th May 1960

"Drugs, Space, and Cybernetics: Evolution to Cyborgs"

Reprinted from
Psychophysiological Aspects of Space Flight

Drugs, Space, and Cybernetics: Evolution to Cyborgs

NATHAN S. KLINE *and* MANFRED CLYNES

A wanderer is man from his birth.
He was born in a ship
On the breast of the river of Time;
Brimming with wonder and joy
He spreads out his arms to the light
Rivets his gaze on the banks of the stream.

As what he sees is, so have his thoughts been.

"The Future" by Matthew Arnold

Man must first conceive that which he would create. Viewed from a cosmic time scale, today we fumble and crawl, having barely crossed the threshold of existence; because a rattle responds when we shake it, we are swollen with instant pride and label ourselves "masters of the universe." We have not yet even learned to conquer disease, we are ignorant as to the basic nature of electric, magnetic, and nuclear forces—of the very nature of force itself. We can only communicate with each other in the most inarticulate fashions, and we do not know how to create life. Our presumption is even greater than our ignorance: when we cannot understand something we call it UNKNOWABLE MYSTERY or ULTIMATE. The Epimetheans among us then cry "sacrilege" when the problem is even approached. As if God's infinity were but a finger's grasp beyond our own limitations!

Participant Evolution. The challenge of space travel to mankind is not only to his technological prowess, it is also a spiritual challenge to take an active part in his own biological evolution. The great scientific advances in the years to come may be utilized to permit existence under environments radically different from those provided by natural circumstances today. This task of adapting his body to whatever milieu he chooses will be made easier by increased knowledge of homeostatic functioning, the cybernetic aspects of which are

"the altering of bodily functions ... achieved without heredity by suitable biochemical, physiological, and electronic modification of man's existing modus vivendi".

"creating self-regulating man-machine systems"

"self-regulation needs to function without the benefit of consciousness"

"cooperate with the body's own autonomous homeostatic controls"

"for the artificially extended homeostatic control system functioning unconsciously, one of us (Manfred Clynes) has coined the term Cyborg"

“the purpose of the Cyborg is to provide an organizational system in which”

“robot-like functions are taken care of automatically and unconsciously”

[no longer]
“a slave to the machine”

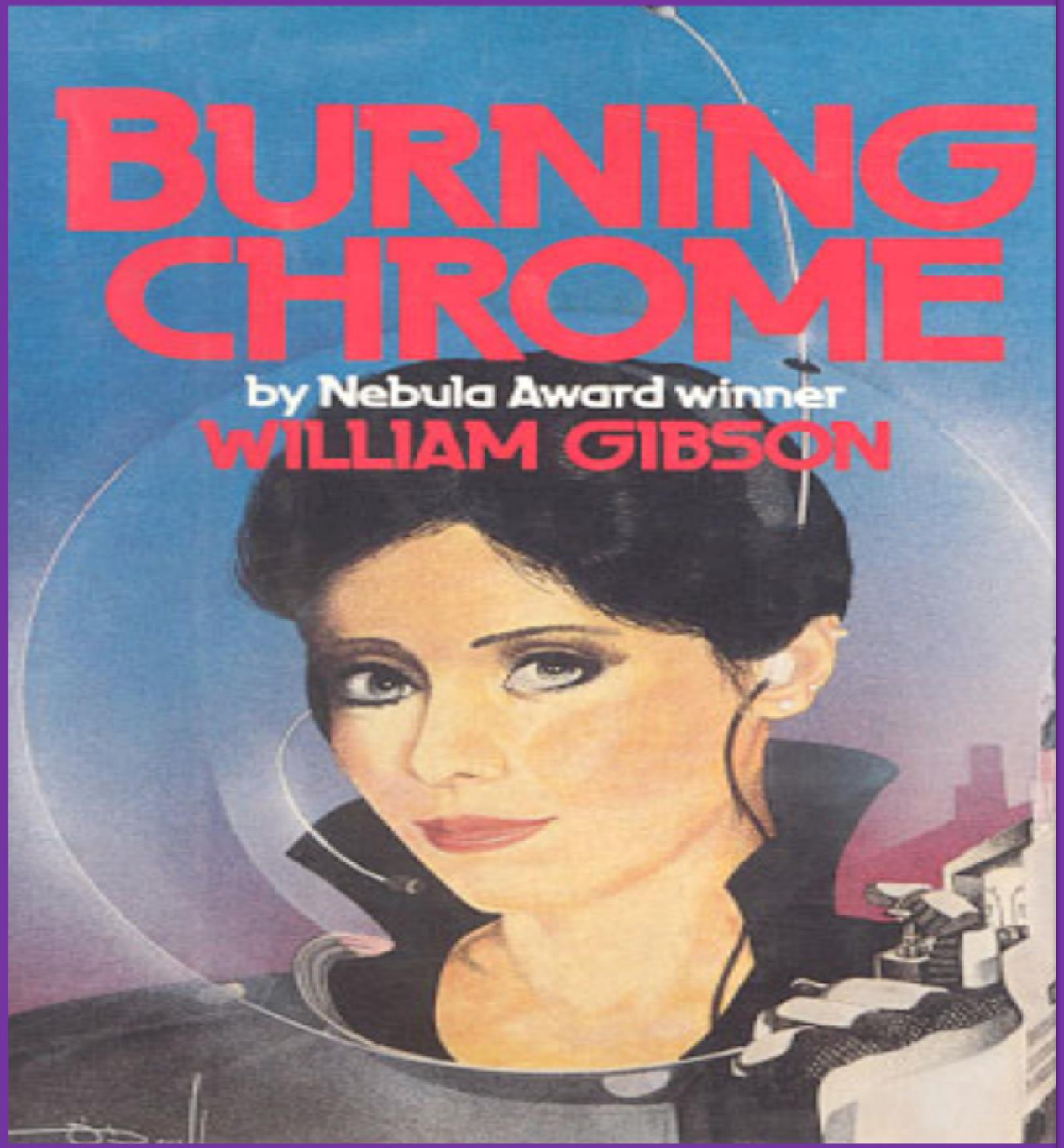
“freeing man to explore, to create, to think, and to feel”,

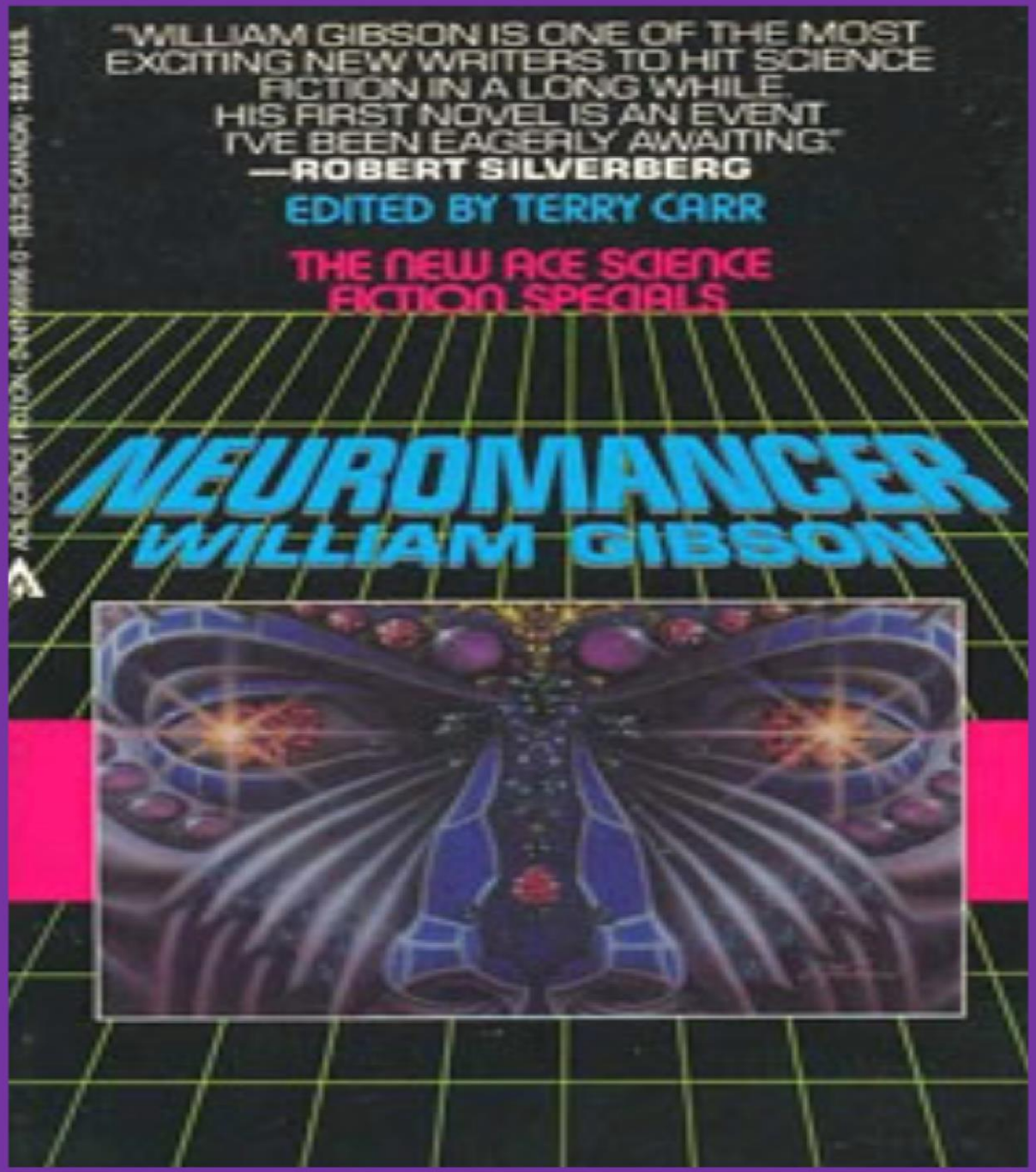
“a new, larger dimension for man’s spirit”.

CYB ernetic

ORG anism


CLAPHAM CYBER CENTRE
FAST INTERNET ACCESS
OPEN 8.30AM - 1
PM
UNLOCKING
WATCHES
COLOUR PRINTING
PC REPAIRS
PHOTOCOPY
FAX
CALLING CARD
TOP UP


BURNING CHROME
by Nebula Award winner
WILLIAM GIBSON

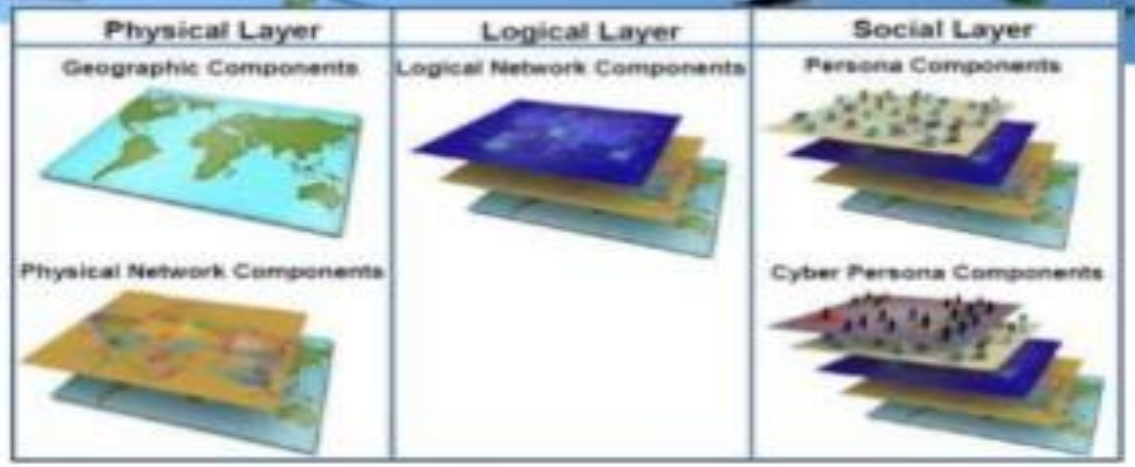

"WILLIAM GIBSON IS ONE OF THE MOST EXCITING NEW WRITERS TO HIT SCIENCE FICTION IN A LONG WHILE. HIS FIRST NOVEL IS AN EVENT I'VE BEEN EAGERLY AWAITING."
—ROBERT SILVERBERG
EDITED BY TERRY CARR
THE NEW ACE SCIENCE FICTION SPECIALS
NEUROMANCER
WILLIAM GIBSON

“Cyberspace. A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphic representation of data abstracted from banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding...”

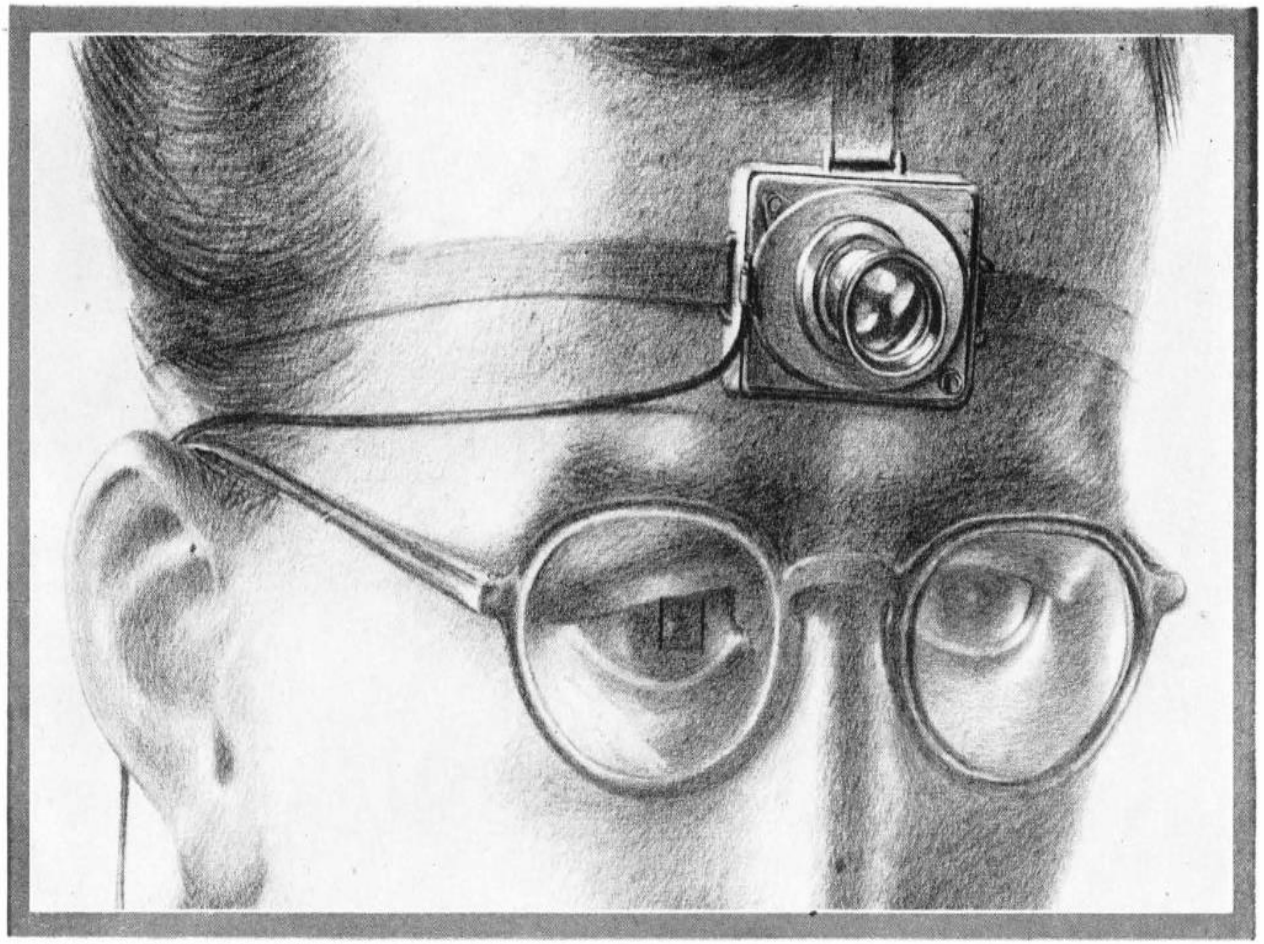
Cyberspace as a Domain

CYBERSPACE: A **global domain** within the information environment consisting of the **interdependent** network of information technology infrastructures, including the **Internet**, **telecommunications** networks, **computer systems**, and embedded **processors** and **controllers.** *(JP 1-02)*

- Man-made domain – ever changing
- **Physical, logical, and social** characteristics
- **Interdependent with traditional war-fighting domains**
- Part of every unit's Operating Environment
- Instantaneous operational reach – **global battlefield**



"Vannevar Bush General Of Physics"



A SCIENTIST OF THE FUTURE RECORDS EXPERIMENTS WITH A TINY CAMERA FITTED WITH UNIVERSAL-FOCUS LENS. THE SMALL SQUARE IN THE EYEGLASS AT THE LEFT SIGHTS THE OBJECT

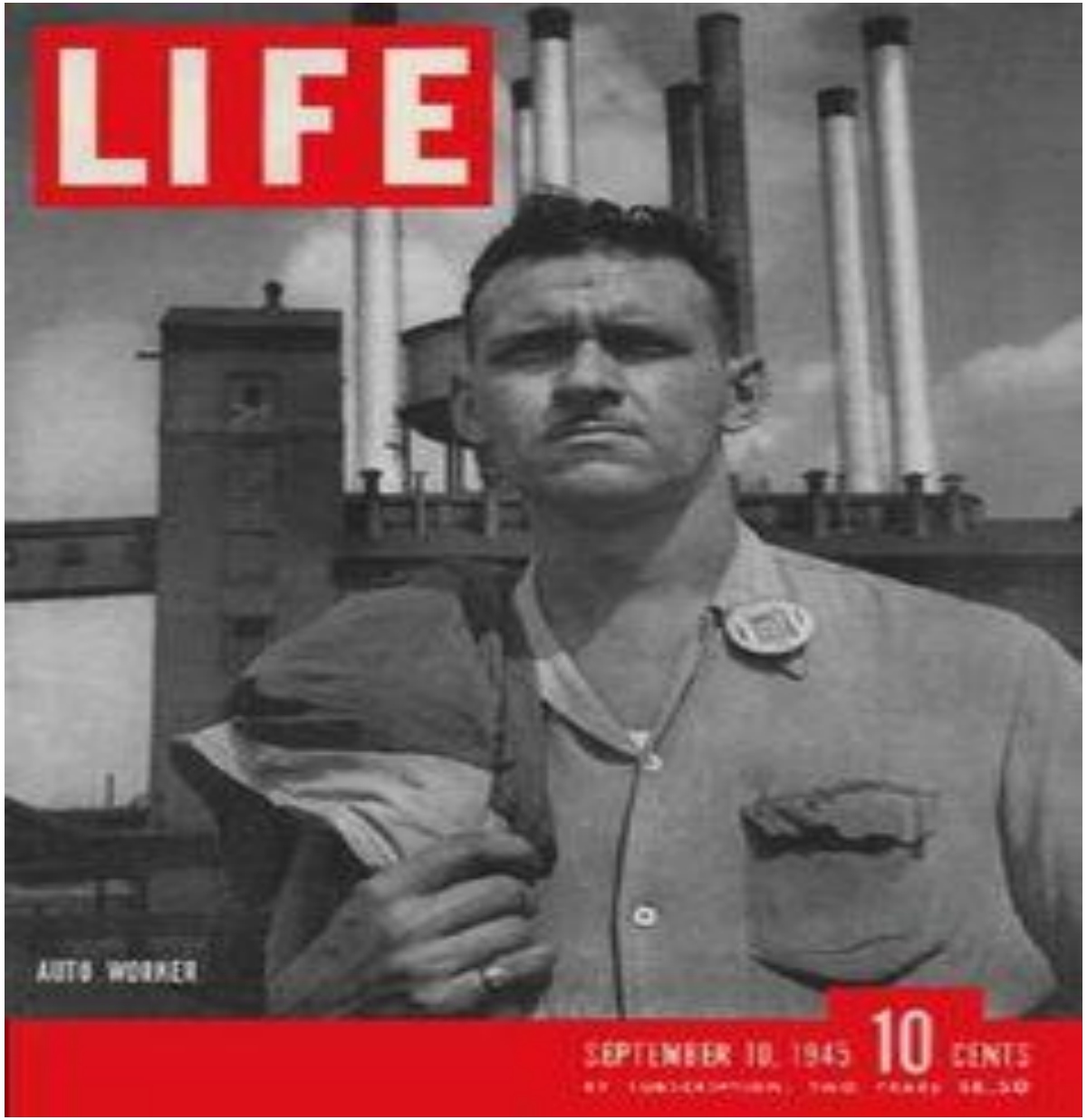
AS WE MAY THINK

A TOP U. S. SCIENTIST FORESEES A POSSIBLE FUTURE WORLD IN WHICH MAN-MADE MACHINES WILL START TO THINK

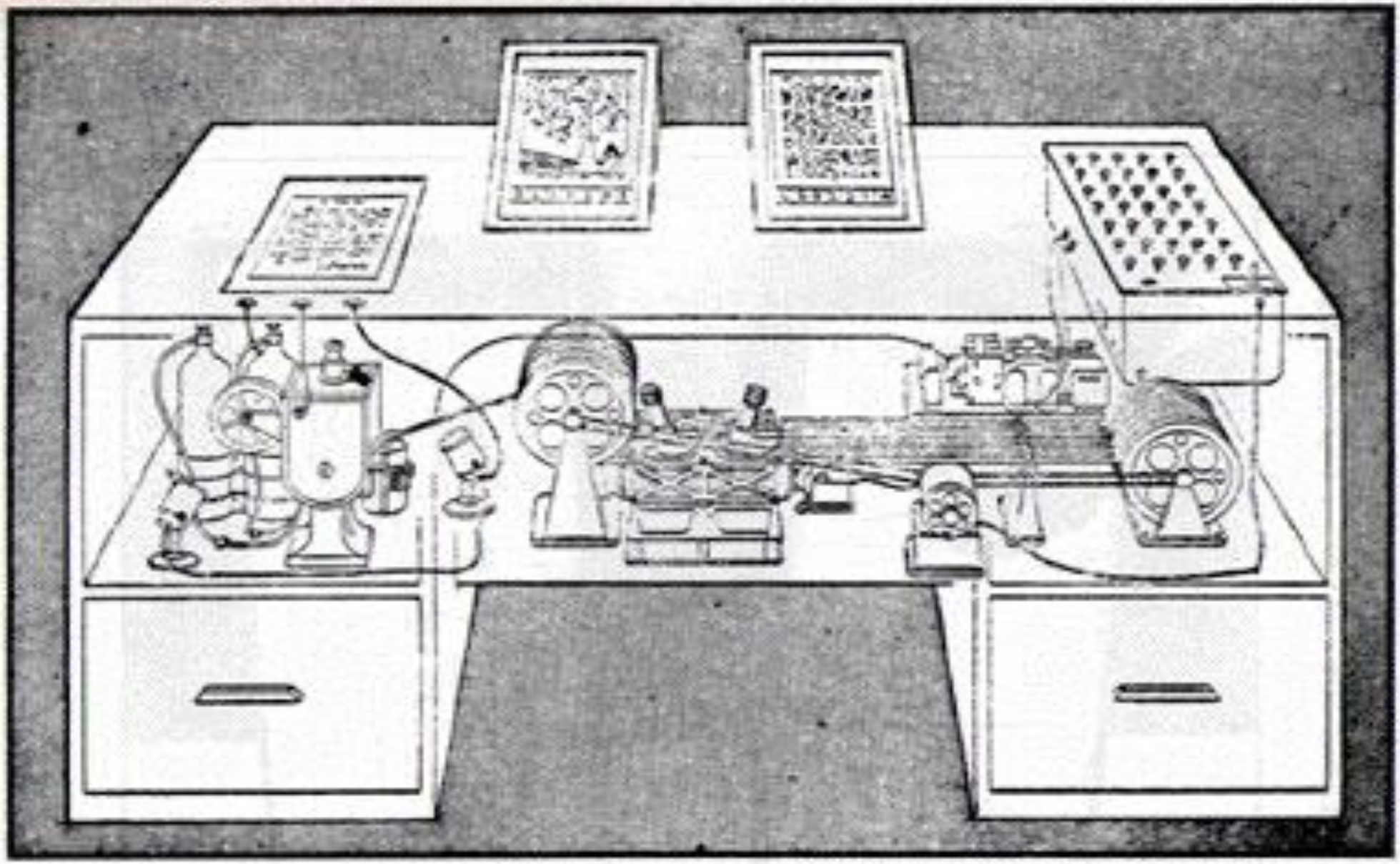
by VANNEVAR BUSH

DIRECTOR OF THE OFFICE OF SCIENTIFIC RESEARCH AND DEVELOPMENT

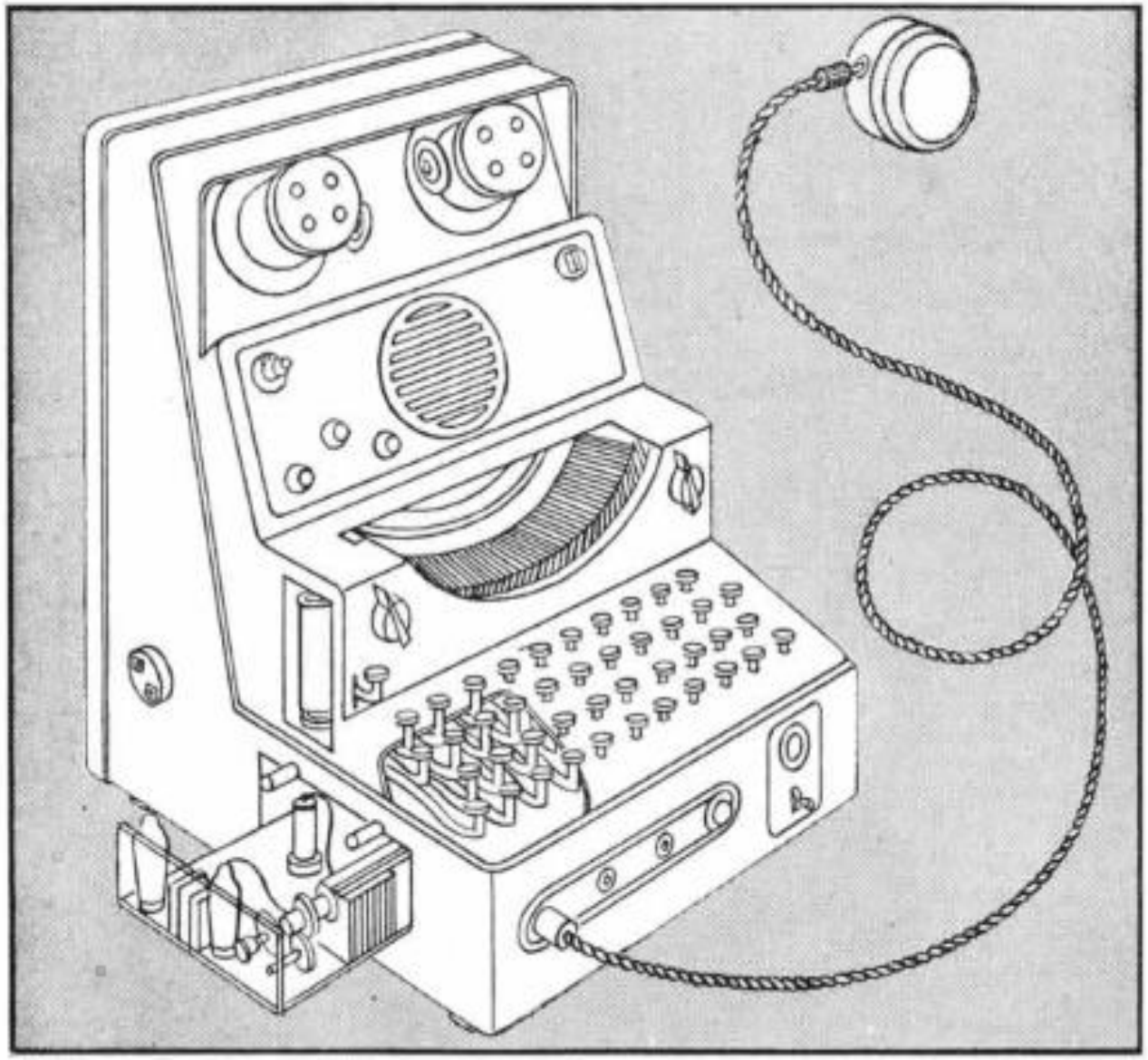
Condensed from the *Atlantic Monthly*, July 1945



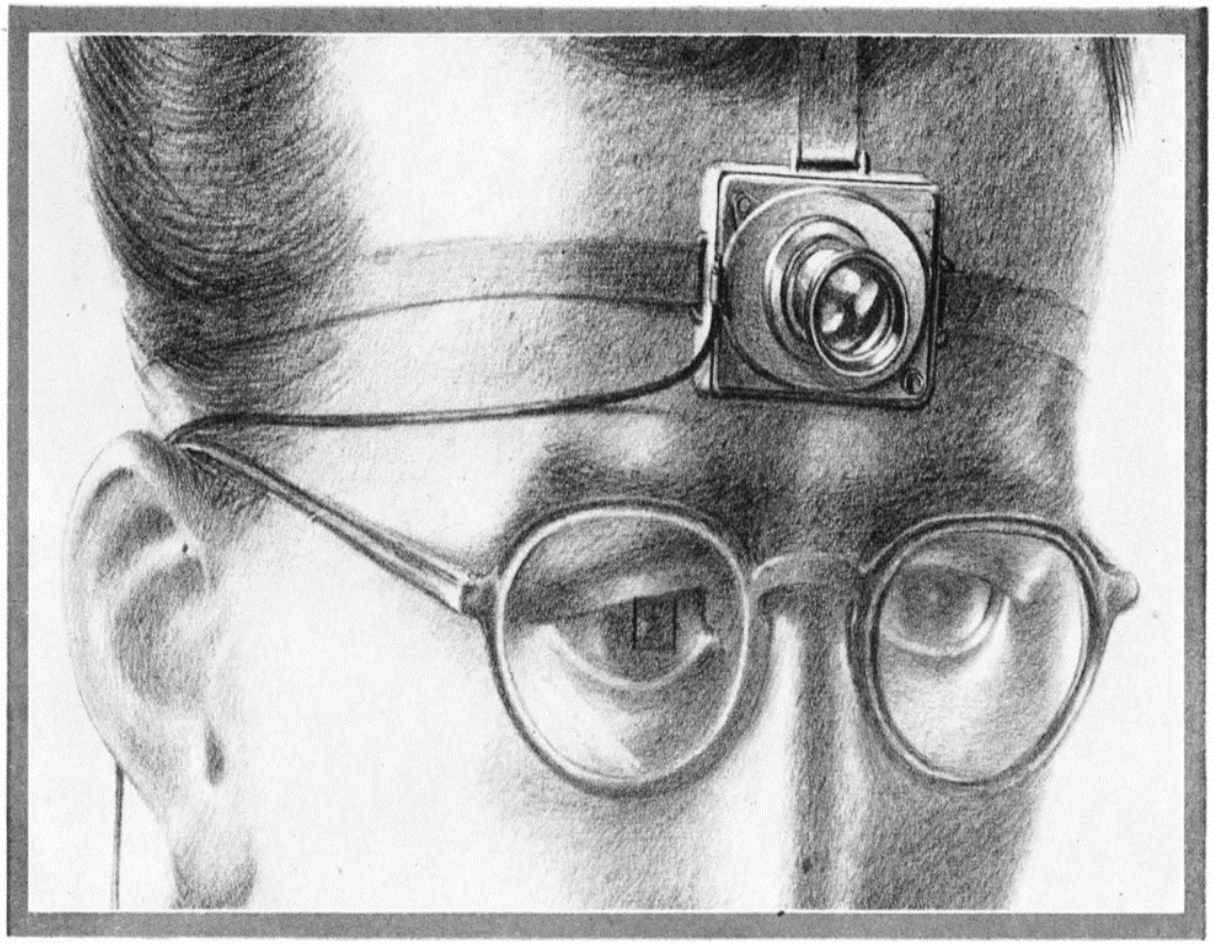
September 10th 1945



Memex in the form of a desk would instantly bring files and material on any subject to the operator's fingertips. Slanting translucent viewing screens magnify supermicrofilm filed by code numbers. At left is a mechanism which automatically photographs longhand notes, pictures and letters, then files them in the desk for future reference (*LIFE 19*(11), p. 123).



SUPERSECRETARY OF THE COMING AGE, the machine contemplated here would take dictation, type it automatically and even talk back if the author wanted to review what he had just said. It is somewhat similar to the Voder seen at New York World's Fair. Like all machines suggested by the diagrams in this article, it is not yet in existence.



A SCIENTIST OF THE FUTURE RECORDS EXPERIMENTS WITH A TINY CAMERA FITTED WITH UNIVERSAL-FOCUS LENS. THE SMALL SQUARE IN THE EYEGLASS AT THE LEFT SIGHTS THE OBJECT

AS WE MAY THINK

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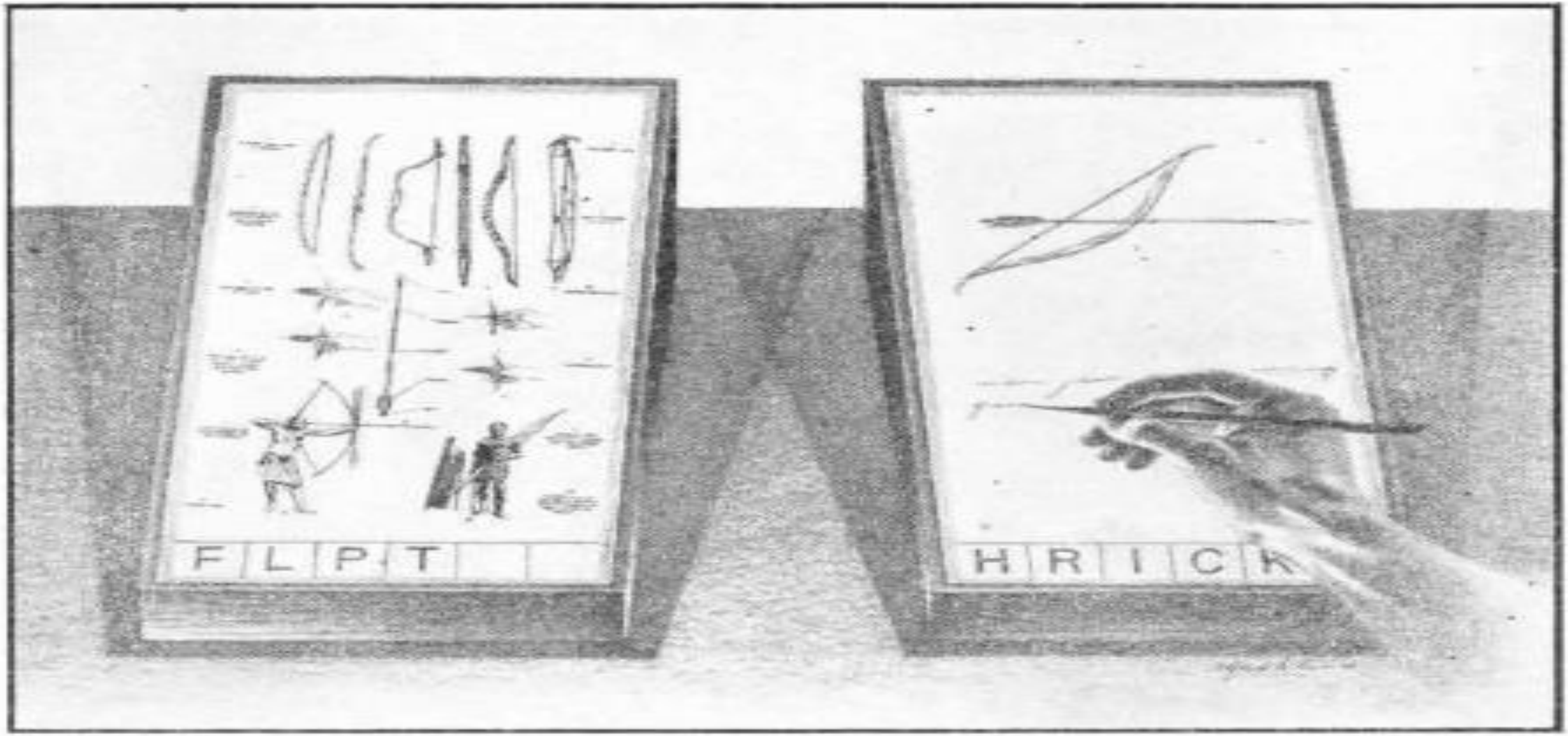
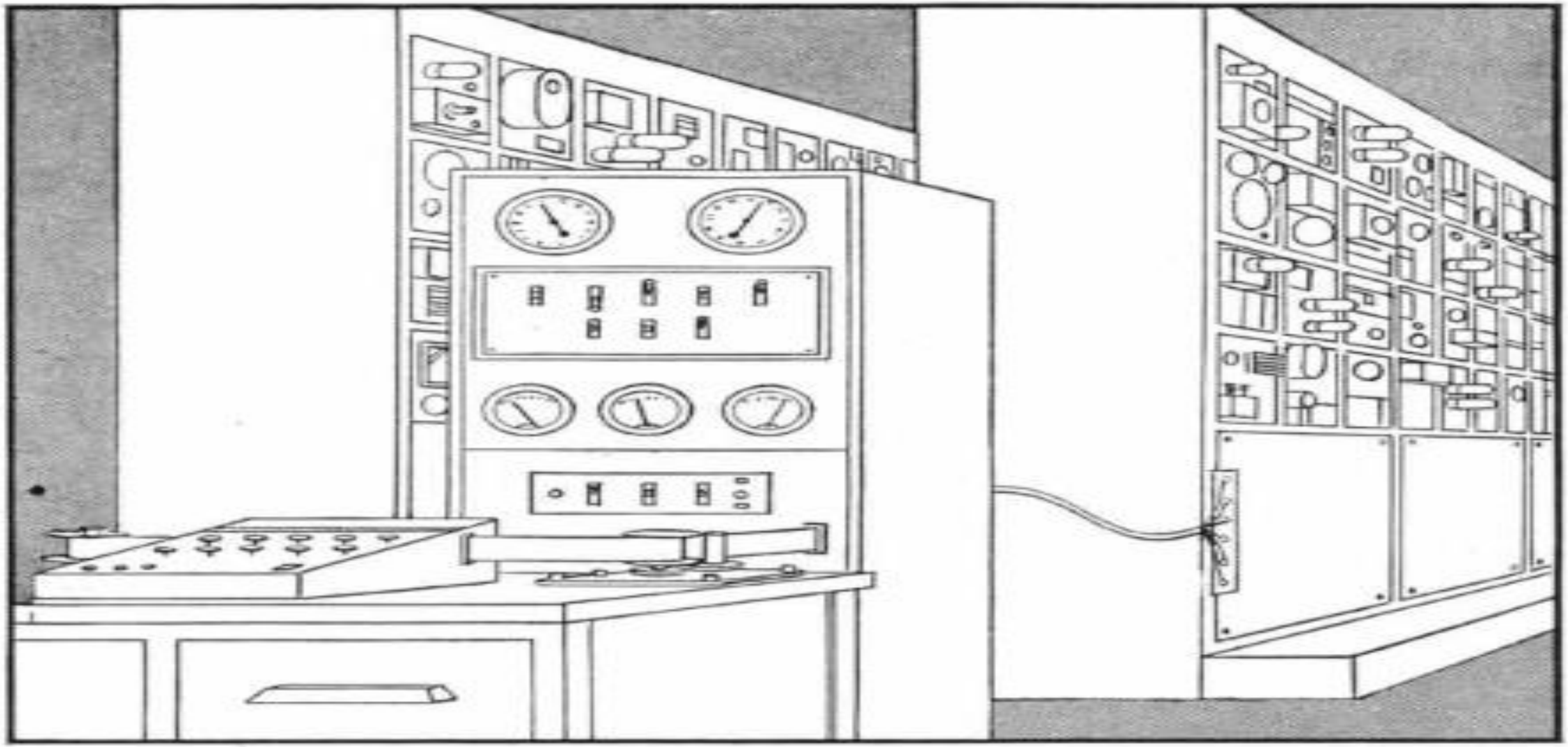
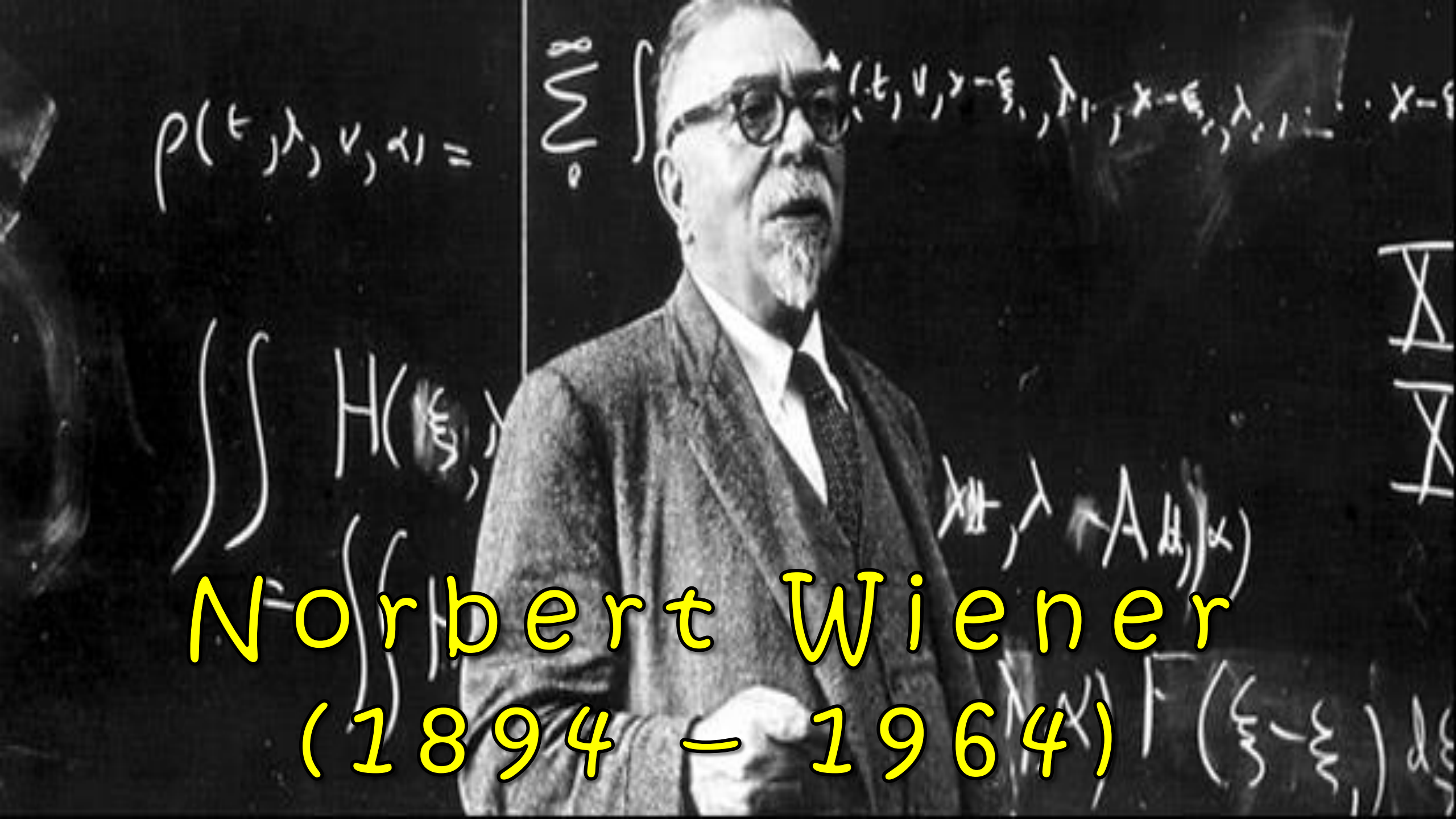


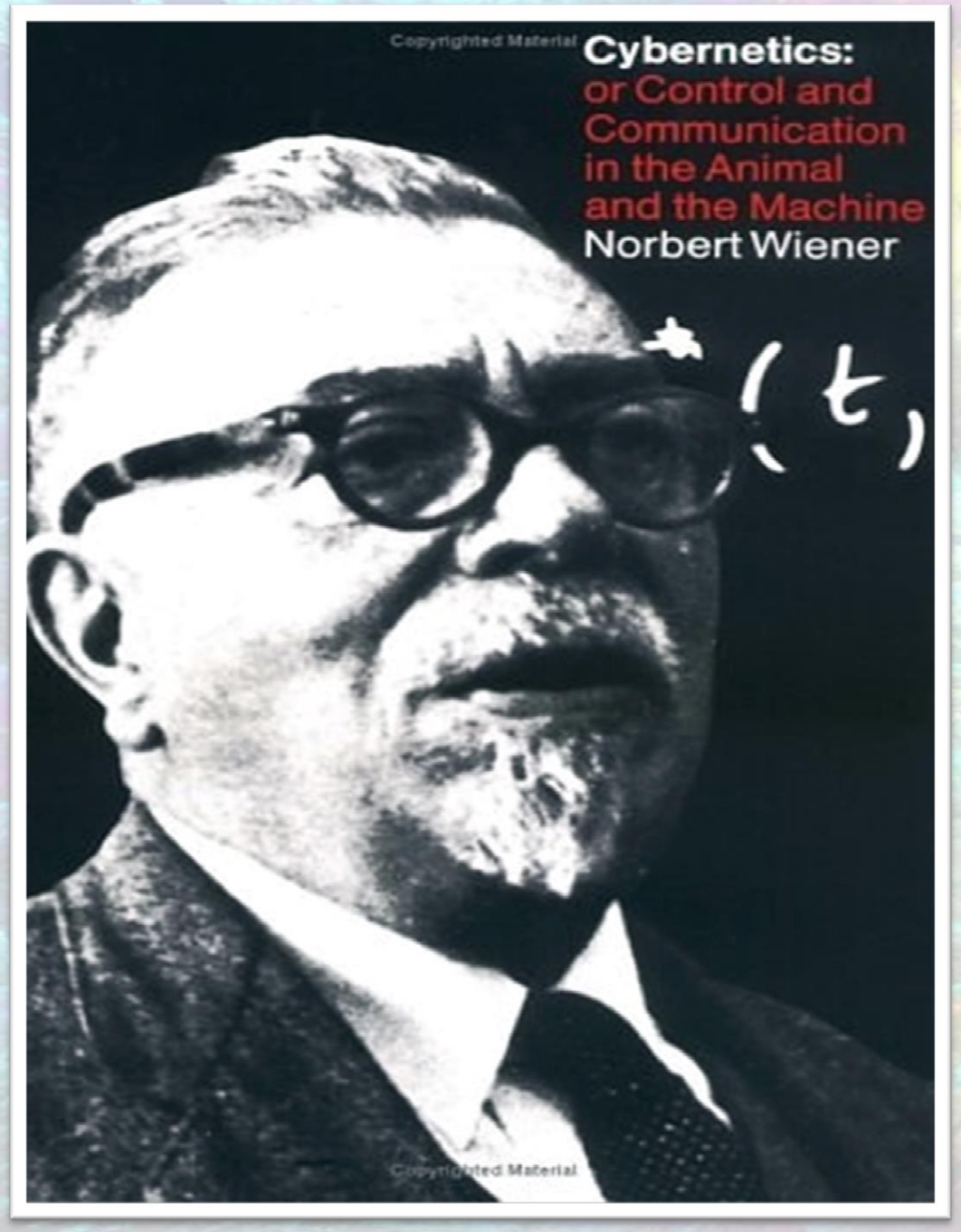
MEMEX IN USE is shown here. On one transparent screen the operator of the future writes notes and commentary dealing with reference material which is projected on the screen at left. Insertion of the proper code symbols at the bottom of right-hand screen will tie the new item to the earlier one after notes are photographed on supermicrofilm.



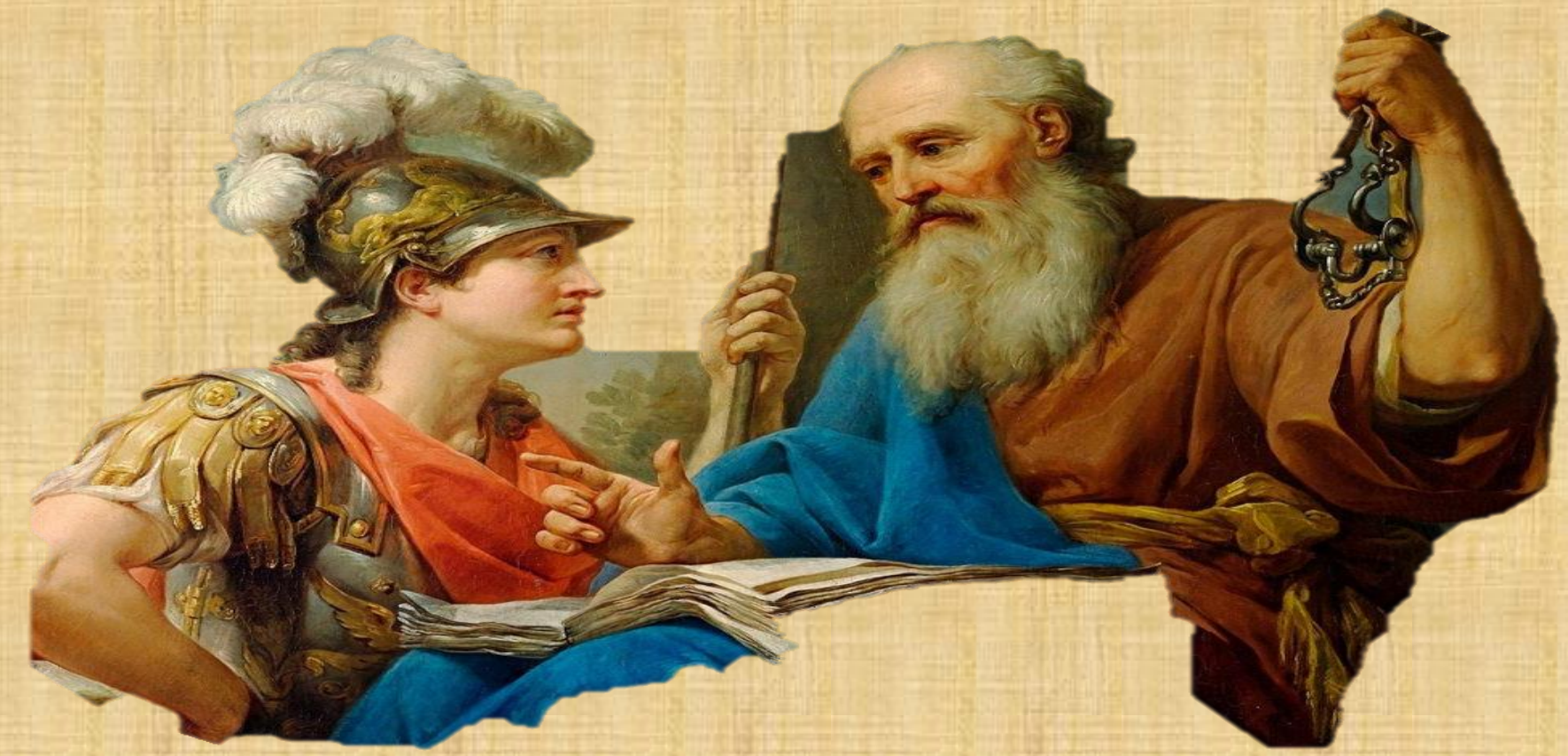
THINKING MACHINES would solve not only the most difficult mathematical problems but even problems of logical thought. Mathematical problems would be fed by punched tape to the electronic device in the racks at rear. Results, accomplished in a fraction of the time it takes man, would be recorded on dials at top and bottom of control board.



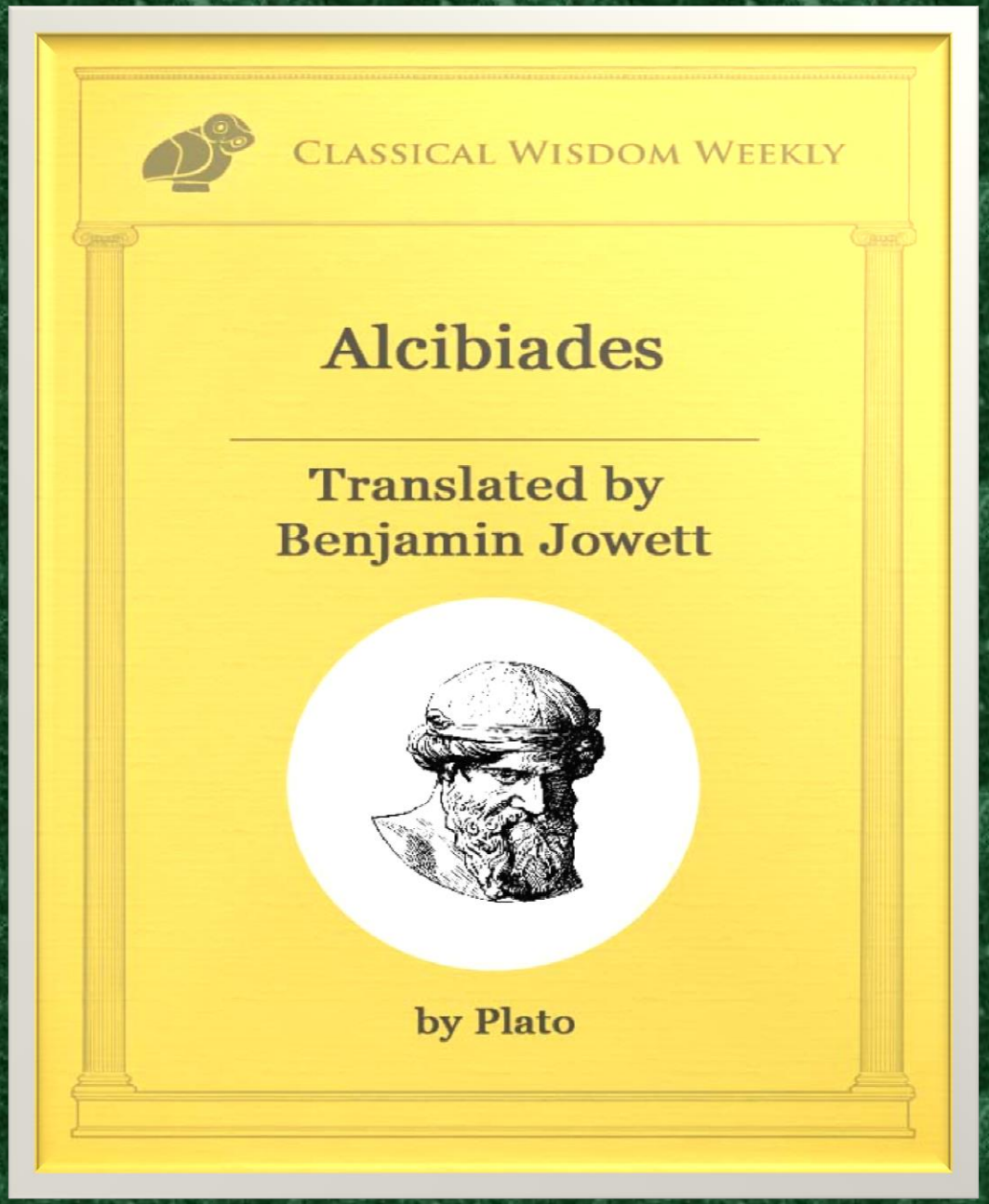
Norbert Wiener
(1894 – 1964)



“the study of non-linear structures and systems, whether electric or mechanical, whether natural or artificial, has needed a fresh and independent point of commencement”



Alcibiades Being Taught by Socrates, 1776-77



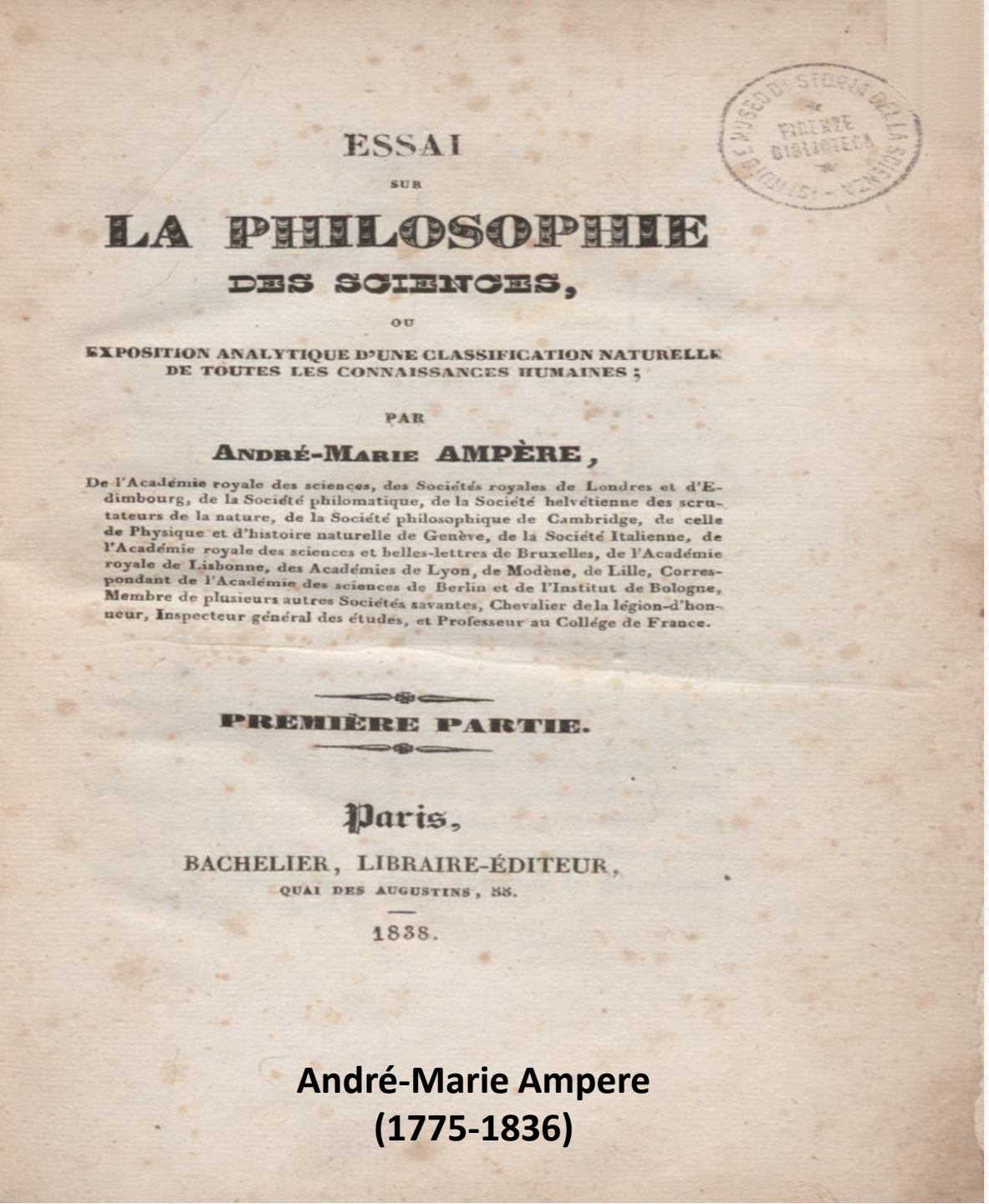
κυβερνητικός
Kybernetikos

(good at steering)

kybernetes
kubernetes

(rudder-man, rudder, steersman, helmsman, skipper)

gubernetes
gubernator



ESSAI

SUR

LA PHILOSOPHIE

DES SCIENCES,

OU

EXPOSITION ANALYTIQUE D'UNE CLASSIFICATION NATURELLE DE TOUTES LES CONNAISSANCES HUMAINES ;

PAR

ANDRÉ-MARIE AMPÈRE,

De l'Académie royale des sciences, des Sociétés royales de Londres et d'Edimbourg, de la Société philomatique, de la Société helvétienne des scrutateurs de la nature, de la Société philosophique de Cambridge, de celle de Physique et d'histoire naturelle de Genève, de la Société Italienne, de l'Académie royale des sciences et belles-lettres de Bruxelles, de l'Académie royale de Lisbonne, des Académies de Lyon, de Modène, de Lille, Correspondant de l'Académie des sciences de Berlin et de l'Institut de Bologne, Membre de plusieurs autres Sociétés savantes, Chevalier de la légion-d'honneur, Inspecteur général des études, et Professeur au Collége de France.

PREMIÈRE PARTIE.

Paris,

BACHELIER, LIBRAIRE-ÉDITEUR,

QUAI DES AUGUSTINS, 55.

1838.

André-Marie Ampere
(1775-1836)

"Essay on the Philosophy of the Sciences" 1834

"Classification of Human Knowledge in Synoptic Tables of the Sciences and Arts"

Three Sub Divisions of Science
Third Order

336

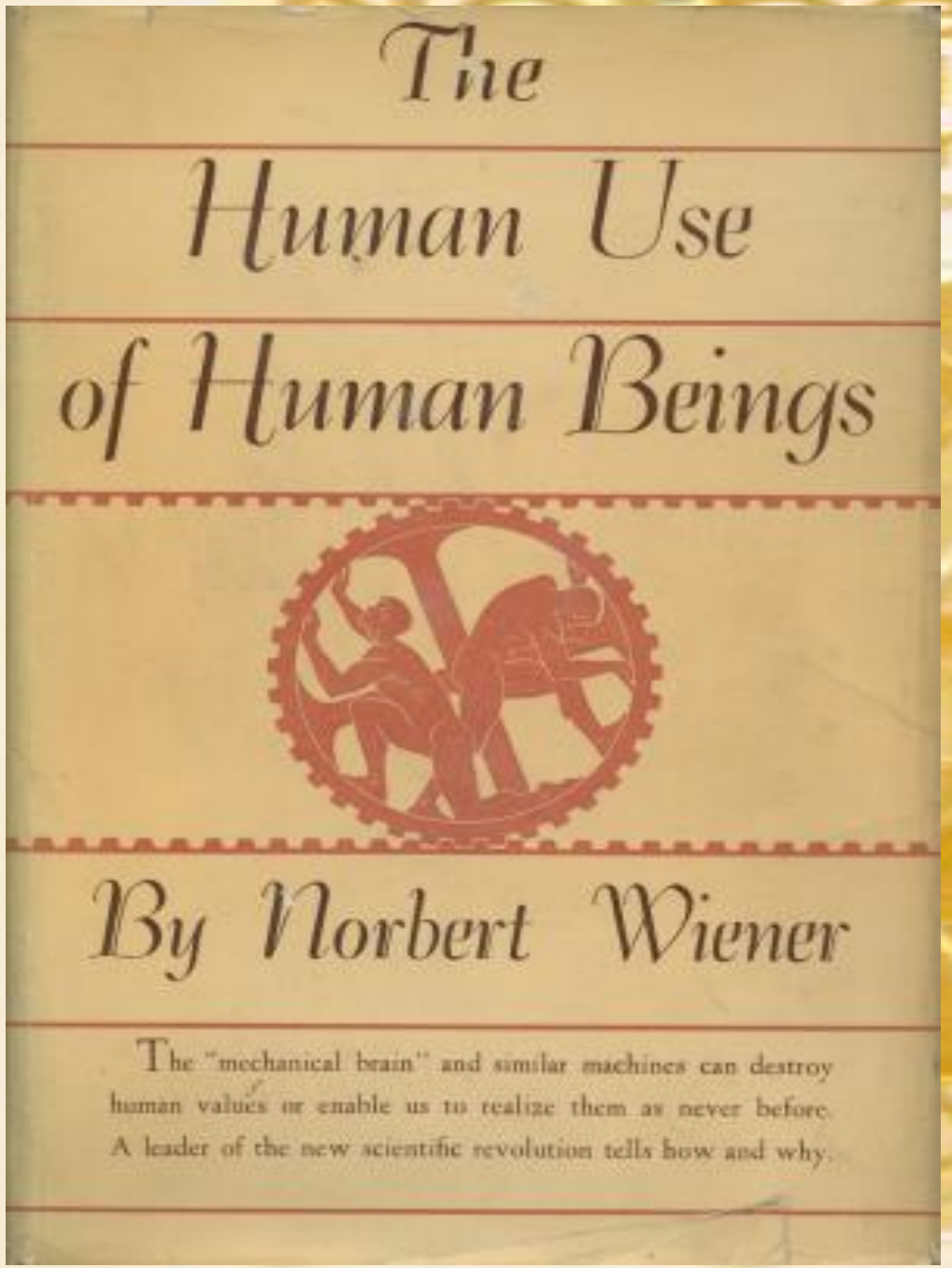
Politique
Cybernétique

"The future science of government should be called 'cybernetics' ('la cybernetique')."

"Use the word 'cybernetics', Norbert, because nobody knows what it means. This will always put you at an advantage in arguments."

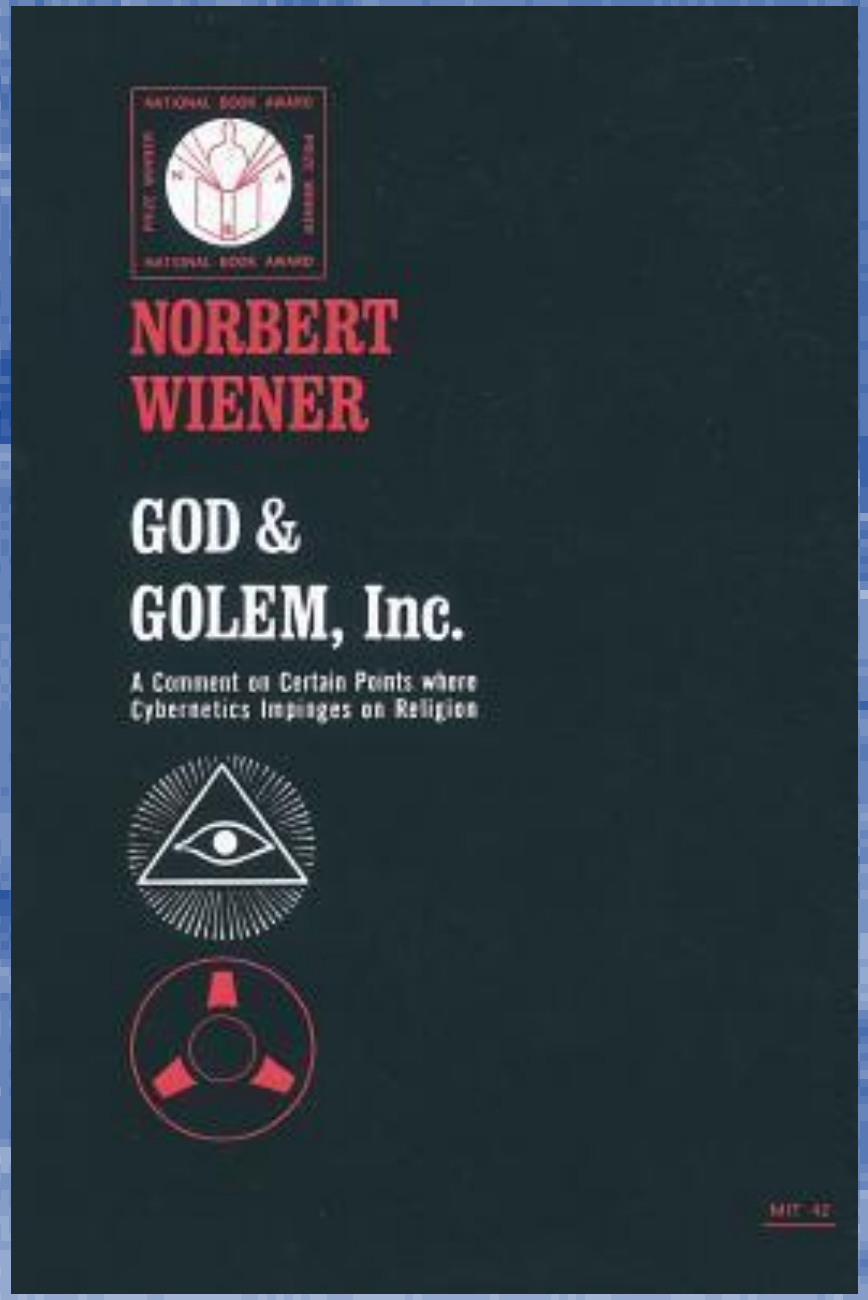
Attributed to

Claude Shannon



First Edition
1950
Second Edition Revised
1954

"The "mechanical brain" and similar machines can destroy human values or enable us to realize them as never before. A leader of the new scientific revolution tells us how and why"



"A Comment on Certain Points where Cybernetics Impinges on Religion"

The

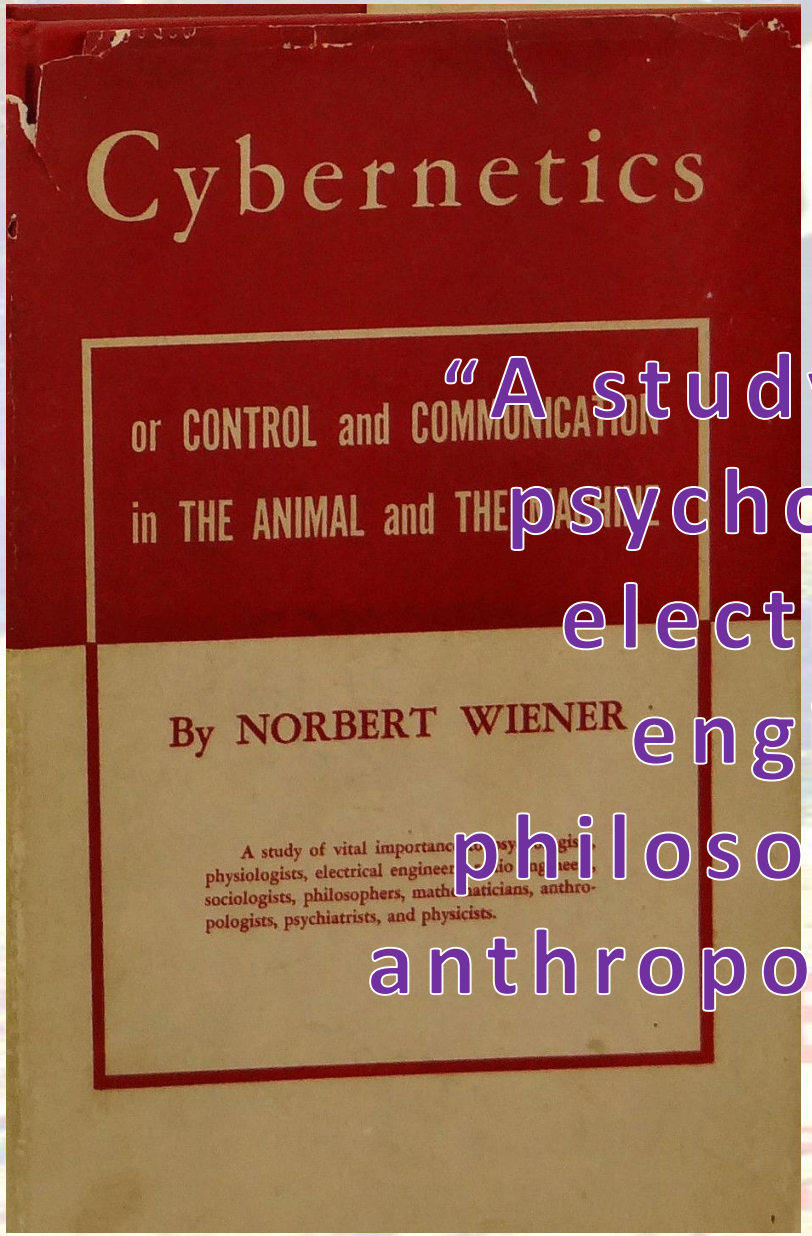
"three points in cybernetics"

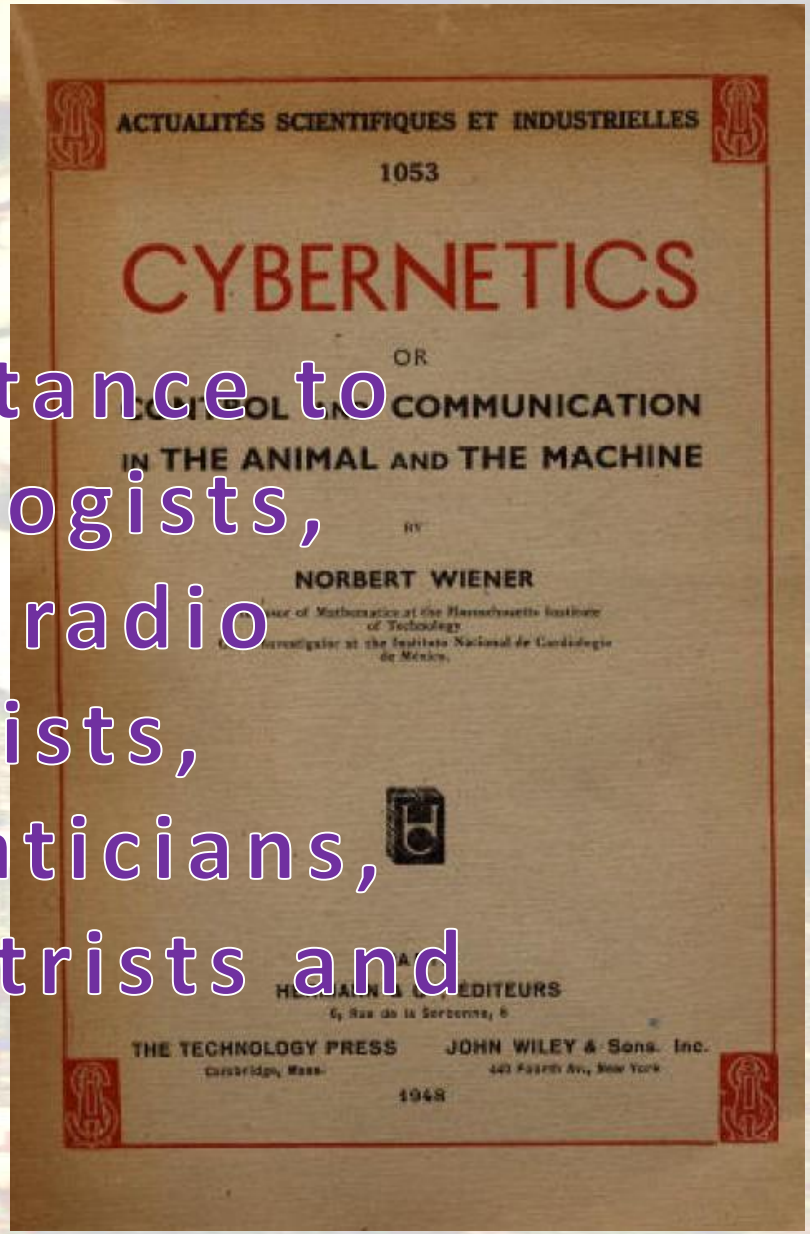
1. "machines which learn"
2. "machines which reproduce themselves"
3. "the coordination of machine and man"

1964

1948

22nd October



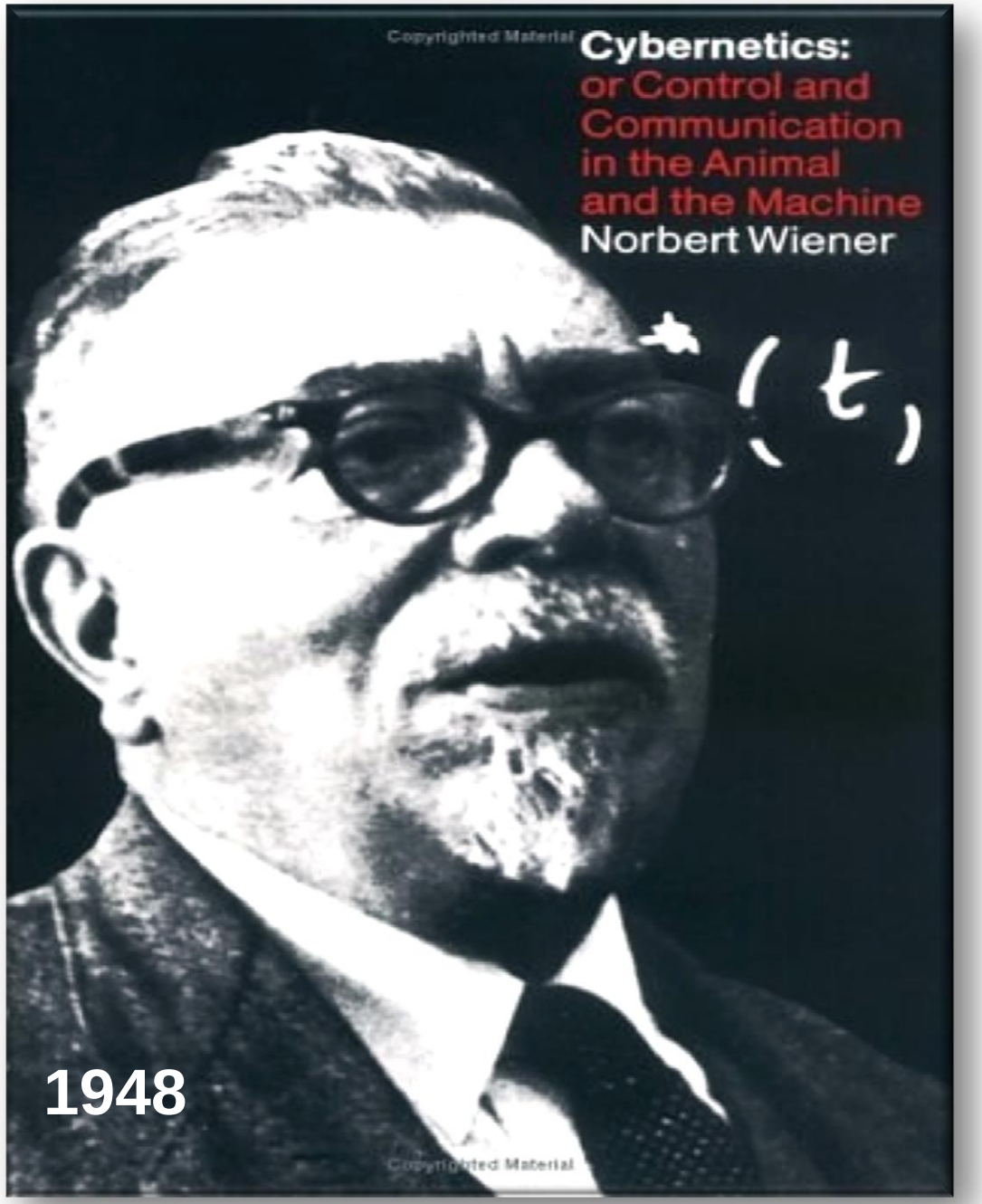


"A study of vital importance to psychologists, physiologists, electrical engineers, radio engineers, sociologists, philosophers, mathematicians, anthropologists, psychiatrists and physicists"

“seminal”

“comparable in ultimate importance to Galileo or Malthus or Rousseau or Mill”

New York Times
Book Review



"There was tremendous intellectual ferment in Cambridge after WWII. Norbert Wiener ran a weekly circle of 40 or 50 people. . . . I was a faithful adherent to that."

J. C. R. Licklider


F. LEGER

Man-Computer Symbiosis*

J. C. R. LICKLIDER†

Summary—Man-computer symbiosis is an expected development in cooperative interaction between men and electronic computers. It will involve very close coupling between the human and the electronic members of the partnership. The main aims are 1) to let computers facilitate formulative thinking as they now facilitate the solution of formulated problems, and 2) to enable men and computers to cooperate in making decisions and controlling complex situations without inflexible dependence on predetermined programs. In the anticipated symbiotic partnership, men will set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations. Computing machines will do the routinizable work that must be done to prepare the way for insights and decisions in technical and scientific thinking. Preliminary analyses indicate that the symbiotic partnership will perform intellectual operations much more effectively than man alone can perform them. Prerequisites for the achievement of the effective, cooperative association include developments in computer time sharing, in memory components, in memory organization, in programming languages, and in input and output equipment.

I. Introduction

A. Symbiosis

THE fig tree is pollinated only by the insect *Blastophaga grossorum*. The larva of the insect lives in the ovary of the fig tree, and there it gets its food. The tree and the insect are thus heavily interdependent: the tree cannot reproduce without the insect; the insect cannot eat without the tree; together, they consitute not only a viable but a productive and thriving partnership. This cooperative "living together in intimate association, or even close union, of two dissimilar organisms" is called symbiosis.[1]

"Man-computer symbiosis" is a subclass of man-machine systems." There are many man-machine systems. At present, however, there are no man-computer symbioses. The purposes of this paper are to present the concept and, hopefully, to foster the development of man-computer symbiosis by analyzing some problems of interaction between men and computing machines, calling attention to applicable principles of man-machine engineering, and pointing out a few questions to which research answers are needed. The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly, and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today.

B. Between "Mechanically Extended Man" and "Artificial Intelligence"

As a concept, man-computer symbiosis is different in an important way from what North[2] has called "mechanically extended man." In the man-machine systems of the past, the human operator supplied the initiative, the direction, the integration, and the criterion. The mechanical parts of the systems were mere extensions, first of the human arm, then of the human eye. These systems certainly did not consist of "dissimilar organisms living together . . ." There was only one kind of organism—man—and the rest was there only to help him.

In one sense of course, any man-made system is intended to help man, to help a man or men outside the system. If we focus upon the human operator(s) within the system, however, we see that, in some areas of technology, a fantastic change has taken place during the last few years. "Mechanical extension" has given way to replacement of men, to automation, and the men who remain are there more to help than to be helped. In some instances, particularly in large computer-centered information and control systems, the human operators are responsible mainly for functions that it proved infeasible to automate. Such systems ("humanly extended machines," North might call them) are not symbiotic systems. They are "semi-automatic" systems, systems that started out to be fully automatic but fell short of the goal.

Man-computer symbiosis is probably not the ultimate paradigm for complex technological systems. It seems entirely possible that, in due course, electronic or chemical "machines" will outdo the human brain in most of the functions we now consider exclusively within its province. Even now, Gelernter's IBM-704 program for proving theorems in plane geometry proceeds at about the same pace as Brooklyn high school students, and makes similar errors.[3] There are, in fact, several theorem-

* Manuscript received by the PGHFE, January 13, 1960; revised manuscript received, January 18, 1960. The background work on which this paper is based was supported largely by the Behavioral Sciences Division, Air Force Office of Scientific Research, Air Research and Development Command, through Contract No. AF-49(638)-355.

† Bolt Beranek and Newman Inc., Cambridge, Mass.

[1] "Webster's New International Dictionary," 2nd ed., G. and C. Merriam Co., Springfield, Mass., p. 2555; 1958.

[2] J. D. North, "The rational behavior of mechanically extended man," Boulton Paul Aircraft Ltd., Wolverhampton, Eng.; September, 1954.

[3] H. Gelernter, "Realization of a Geometry Theorem Proving Machine," Unesco, NS, ICIP, 1.6.6, Internatl. Conf. on Information Processing, Paris, France; June, 1959.

1960

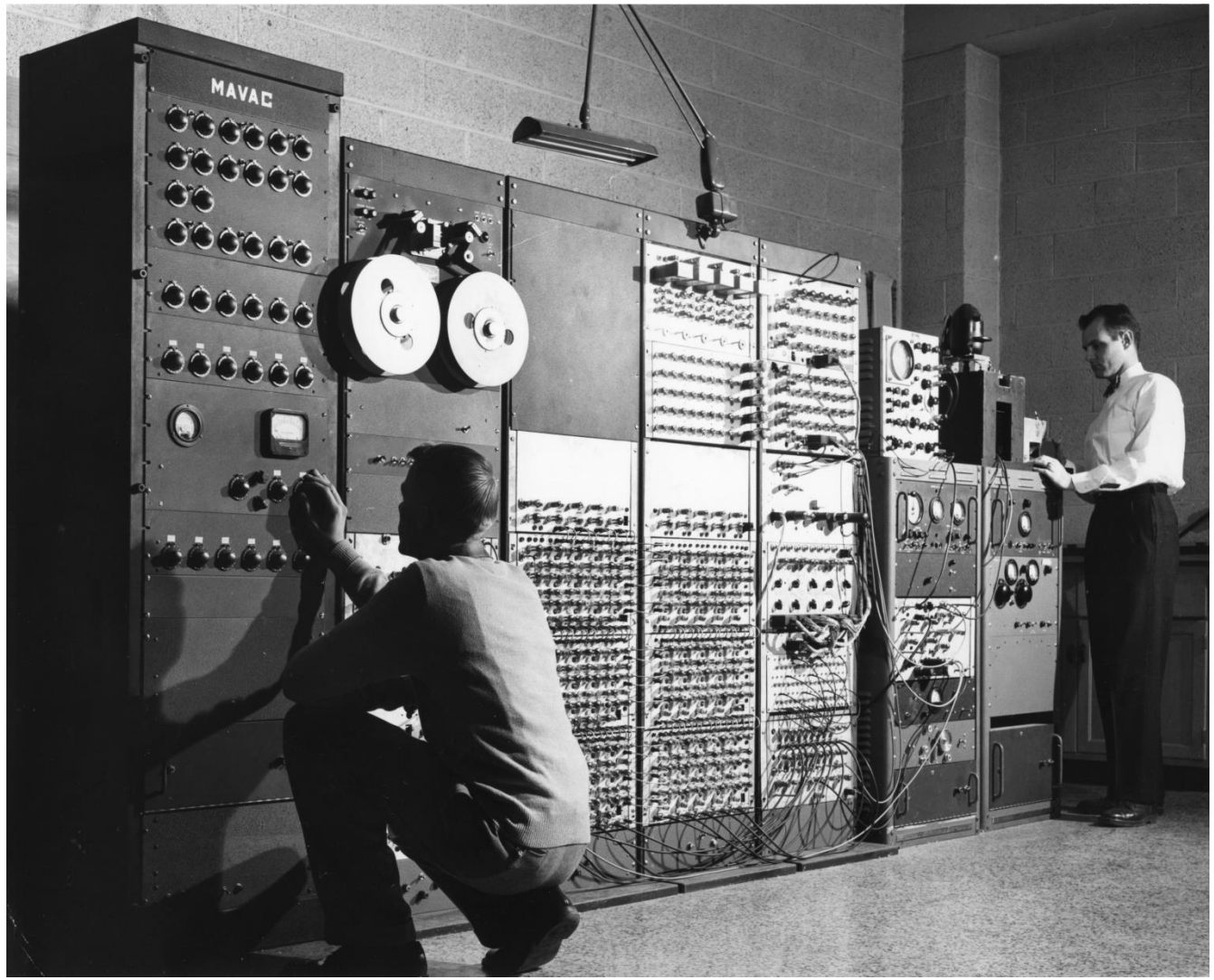
Summary—Man-computer symbiosis is an expected development in cooperative interaction between men and electronic computers. It will involve very close coupling between the human and the electronic members of the partnership. The main aims are 1) to let computers facilitate formulative thinking as they now facilitate the solution of formulated problems, and 2) to enable men and computers to cooperate in making decisions and controlling complex situations without inflexible dependence on predetermined programs. In the anticipated symbiotic partnership, men will set the goals, formulate the hypotheses, determine the criteria, and perform the evaluations. Computing machines will do the routinizable work that must be done to prepare the way for insights and decisions in technical and scientific thinking. Preliminary analyses indicate that the symbiotic partnership will perform intellectual operations much more effectively than man alone can perform them. Prerequisites for the achievement of the effective, cooperative association include developments in computer time sharing, in memory components, in memory organization, in programming languages, and in input and output equipment.

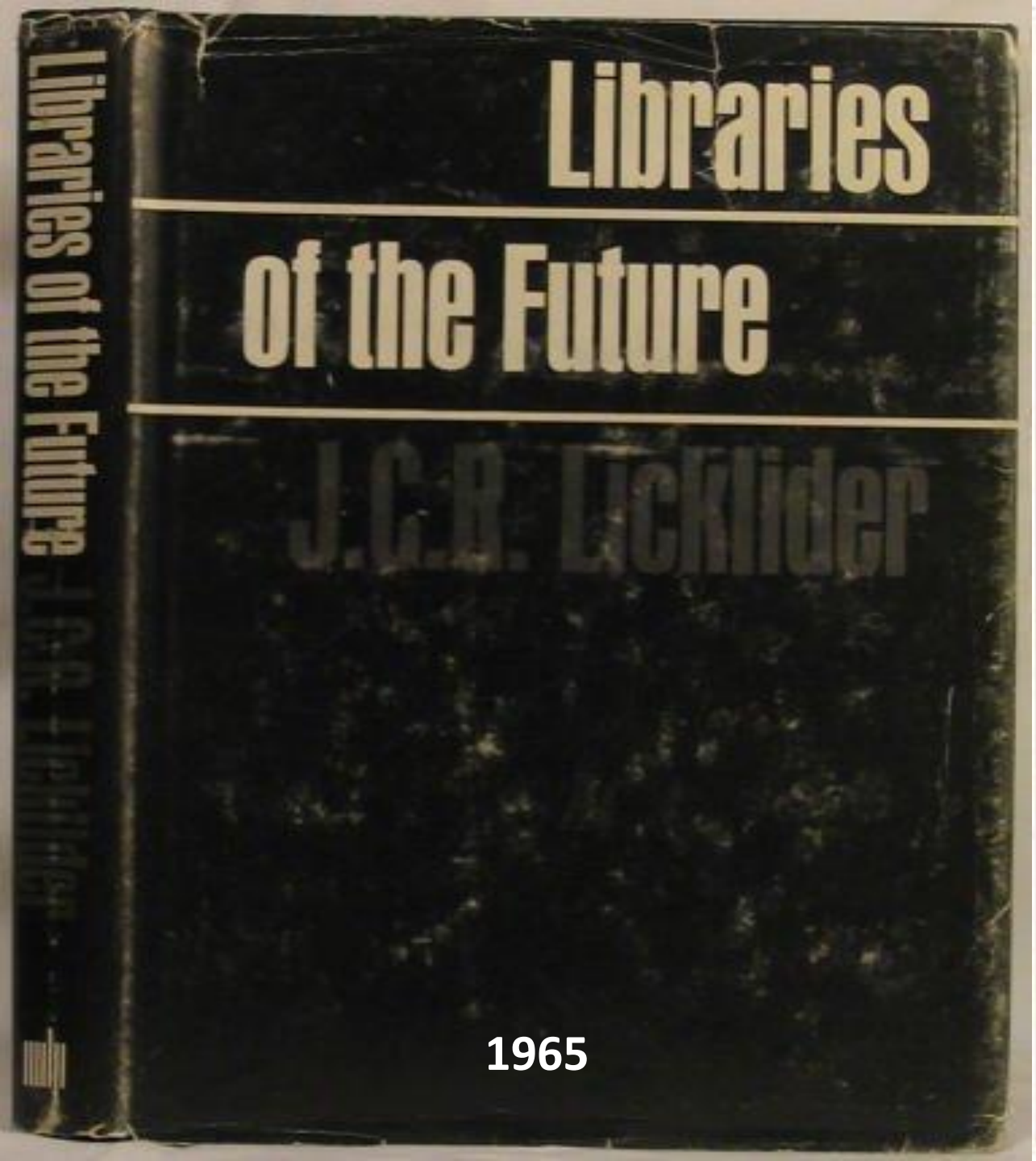
MAN-COMPUTER SYMBIOSIS

> The hope is that, in not too many years, human brains and computing machines will be coupled together very tightly and that the resulting partnership will think as no human brain has ever thought and process data in a way not approached by the information-handling machines we know today.

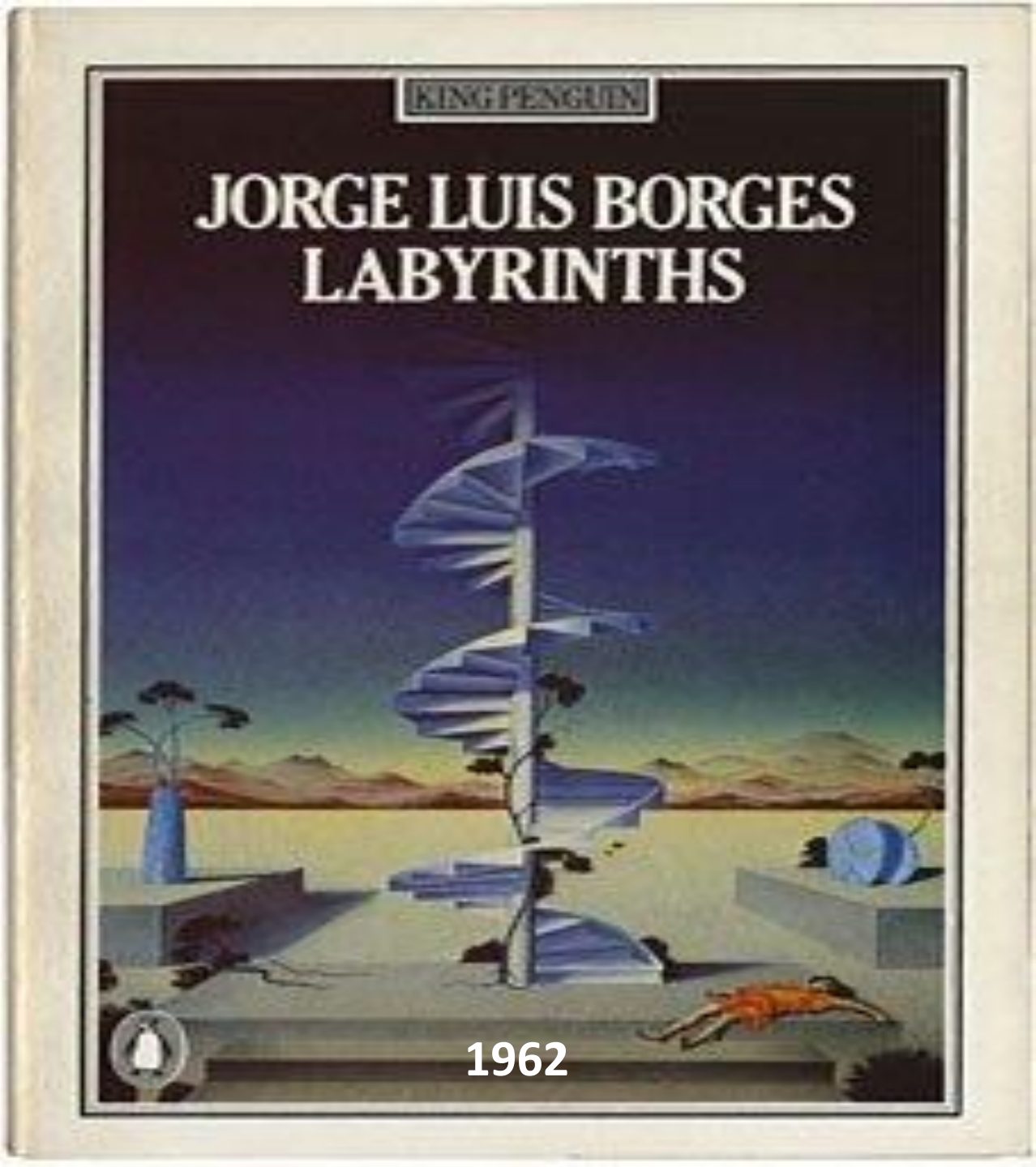
—J.C.R. Licklider
Man-Computer Symbiosis


TOGETHER
WE CAN DO IT!
HUMAN
COMPUTER
SYNAPSES
KEEP 'EM
FIRING!


MAVAC


Libraries of the Future
J.C.R. Licklider
Libraries
of the Future
J.C.R. Licklider

1965


KING PENGUIN
JORGE LUIS BORGES
LABYRINTHS

1962

PART I

MAN'S INTERACTION WITH RECORDED KNOWLEDGE

CHAPTER 4

- Man-Computer Interaction in Procognitive Systems
- The Physical "Intermedium"
- Man-Computer Interaction Languages
- Adaptive Self-Organization in Man-Computer Interaction

PART II

EXPLORATIONS IN THE USE OF COMPUTERS IN LIBRARY AND PROCOGNITIVE FUNCTIONS

“Let us return now to the problem of schemata from which to construct future systems to facilitate man's interaction with transformable information. As a shorter term for such systems, let us use "procognitive systems.“”

We need to substitute for the book a device that will make it easy to transmit information without transporting material.

— J. C. R. Licklider —

AZ QUOTES

ADVANCED RESEARCH PROJECTS AGENCY

Washington 25, D.C. April 23, 1963

MEMORANDUM FOR: Members and Affiliates of the Intergalactic Computer Network

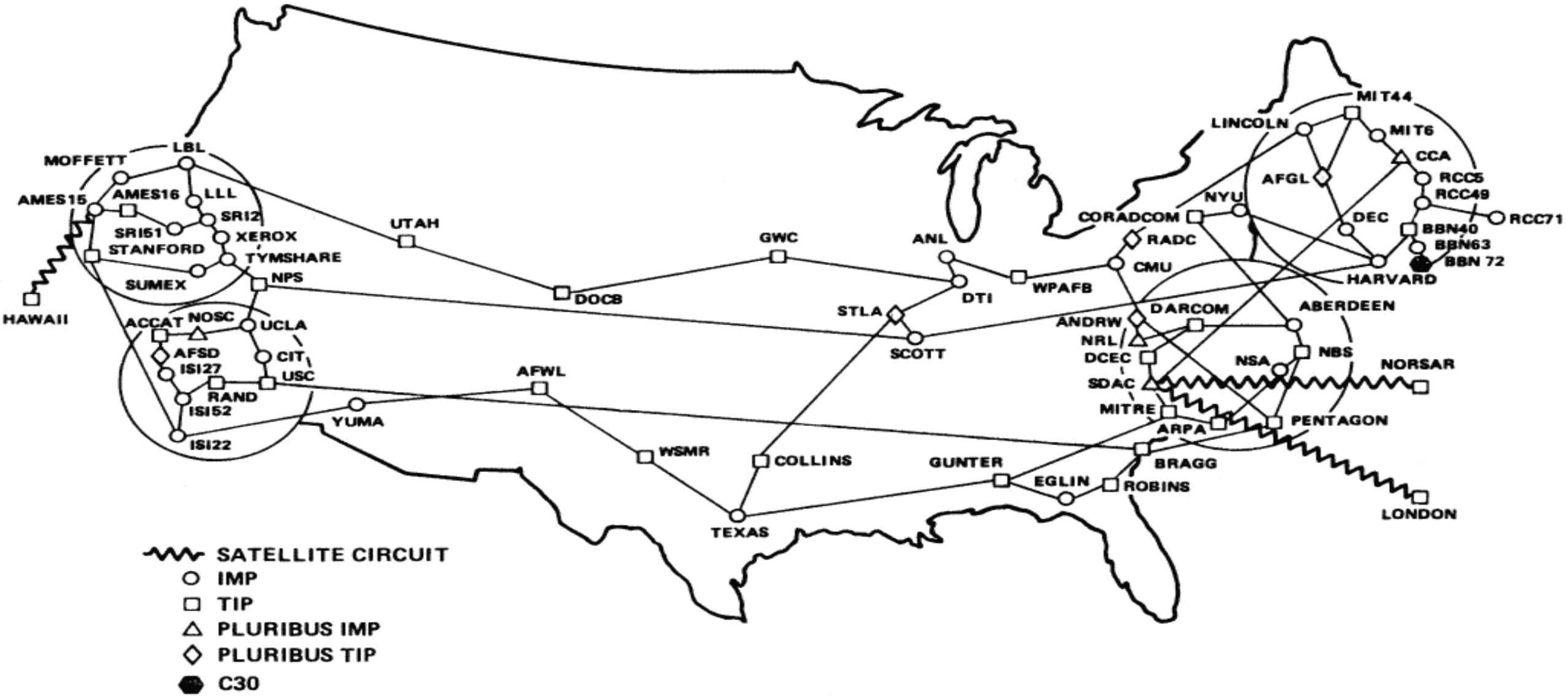
FROM: J. C. R. Licklider

SUBJECT: Topics for Discussion at the Forthcoming Meeting

First, I apologize humbly for having to postpone the meeting scheduled for 3 May 1963 in Palo Alto. The ARPA Command & Control Research office has just been assigned a new task that must be activated immediately, and I must devote the whole of the coming week to it. The priority is externally enforced. I am extremely sorry to inconvenience those of you who have made plans for May 3rd. Inasmuch as I shall be in Cambridge the rest of this week, I am asking my colleagues here to re-schedule the meeting, with May 10th, Palo Alto, as target time and place.

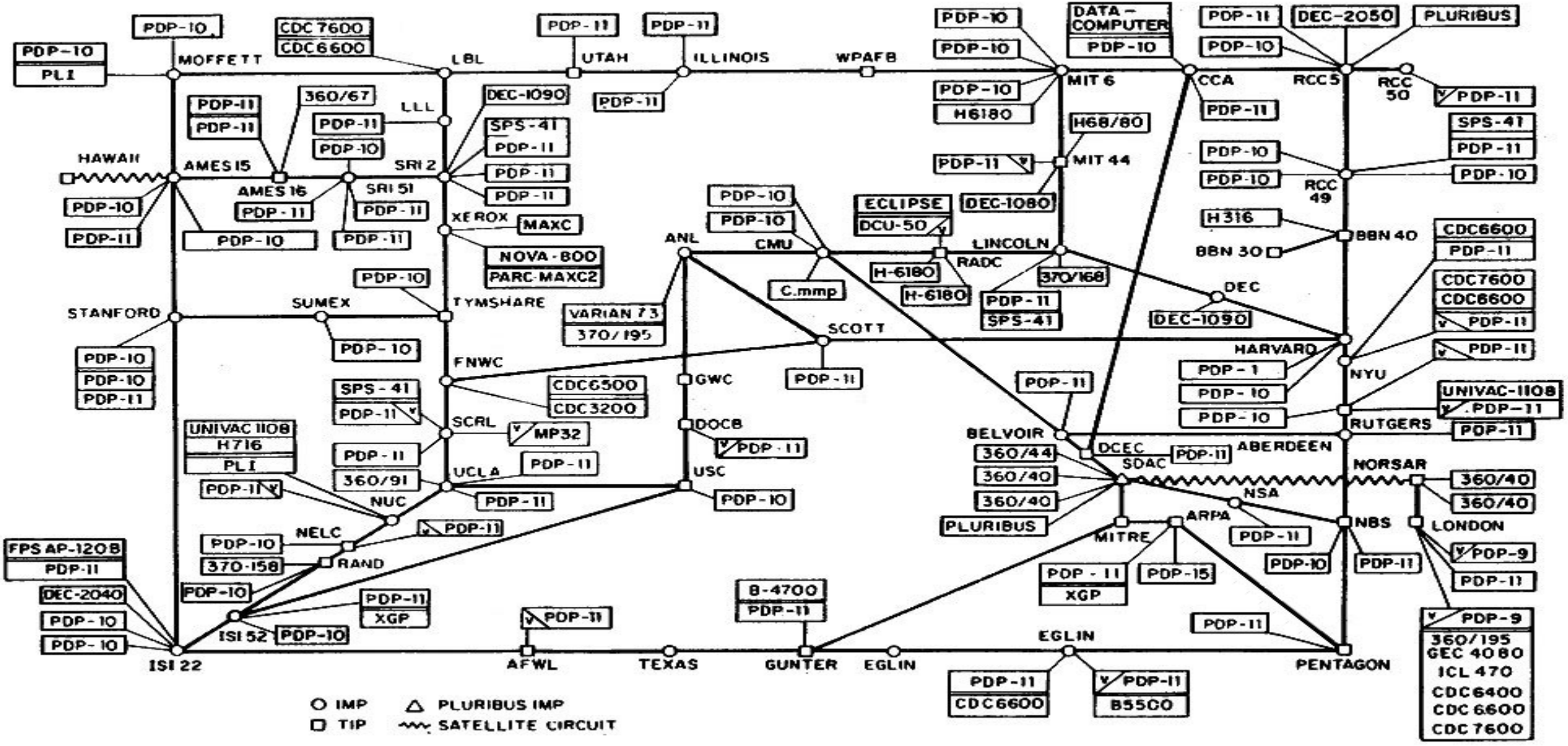
The [redacted] in December 1969

GEOGRAPHIC MAP, OCTOBER 1980



(NOTE: THIS MAP DOES NOT SHOW ARPA'S EXPERIMENTAL SATELLITE CONNECTIONS)
NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

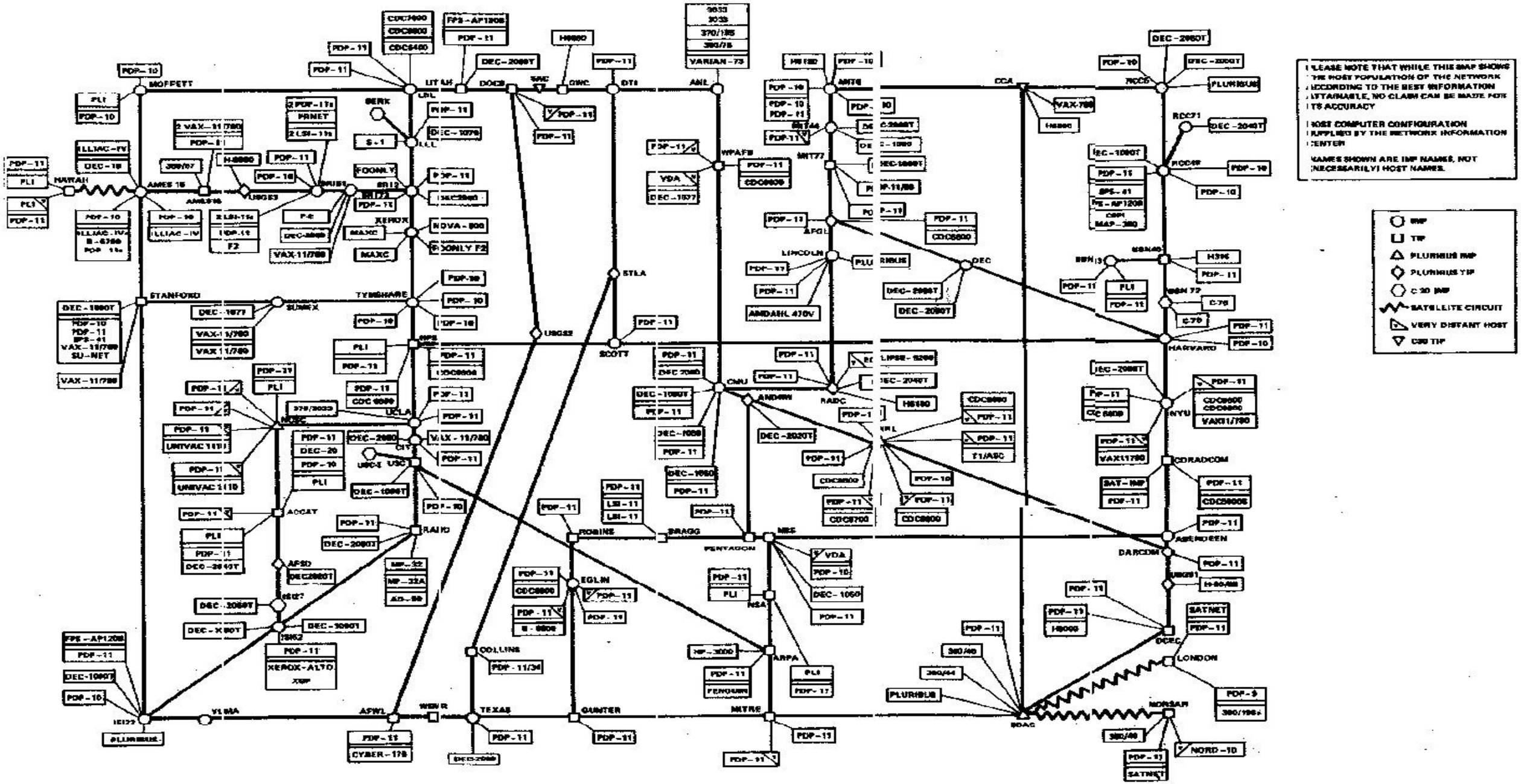
LOGICAL MAP, MARCH 1977



(PLEASE NOTE THAT WHILE THIS MAP SHOWS THE HOST POPULATION OF THE NETWORK ACCORDING TO THE BEST INFORMATION OBTAINABLE, NO CLAIM CAN BE MADE FOR ITS ACCURACY)

NAMES SHOWN ARE IMP NAMES, NOT (NECESSARILY) HOST NAMES

LOGICAL MAP, JUNE 1981



ARPANET

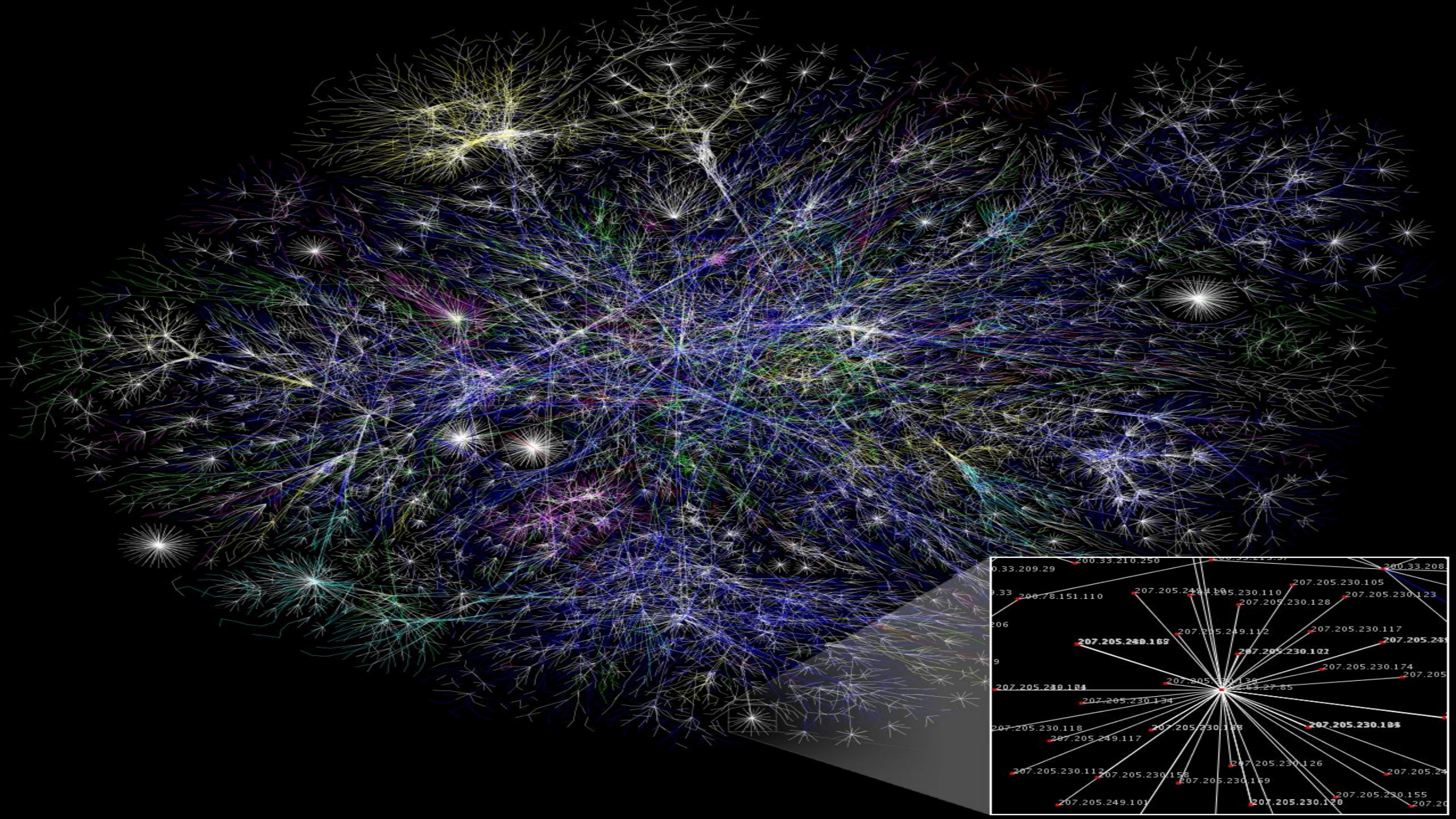
US Department of Defence
Advanced Research Projects Agency

Behavioral Sciences & Command & Control Programs

J C R Licklidder
“Intergalactic Computer Network”

First e-mail sent in 1971

1983: The migration of the ARPANET to TCP/IP is officially completed (this is considered to be the beginning of the true internet).


200.33.210.250
207.205.230.105
200.78.151.110
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207.205.230.126
207.205.230.112
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207.205.249.101
207.205.230.170

The Computer as a Communication Device

J.C.R. Licklider and Robert W. Taylor

Reprinted from *Science and Technology*, April 1968.

This paper was also reprinted in:
In Memoriam: J. C. R. Licklider 1915-1990
Research Report 61
Digital Equipment Corporation Systems Research Center
August 1990
http://gatekeeper.dec.com/pub/DEC/SRC/research-reports/abstracts/src-rr-061.html

“ … a broad class of human endeavor which may be described as creative informational activity.

Let us differentiate this from another class which we will call informational housekeeping.”

“Face to face through a computer”

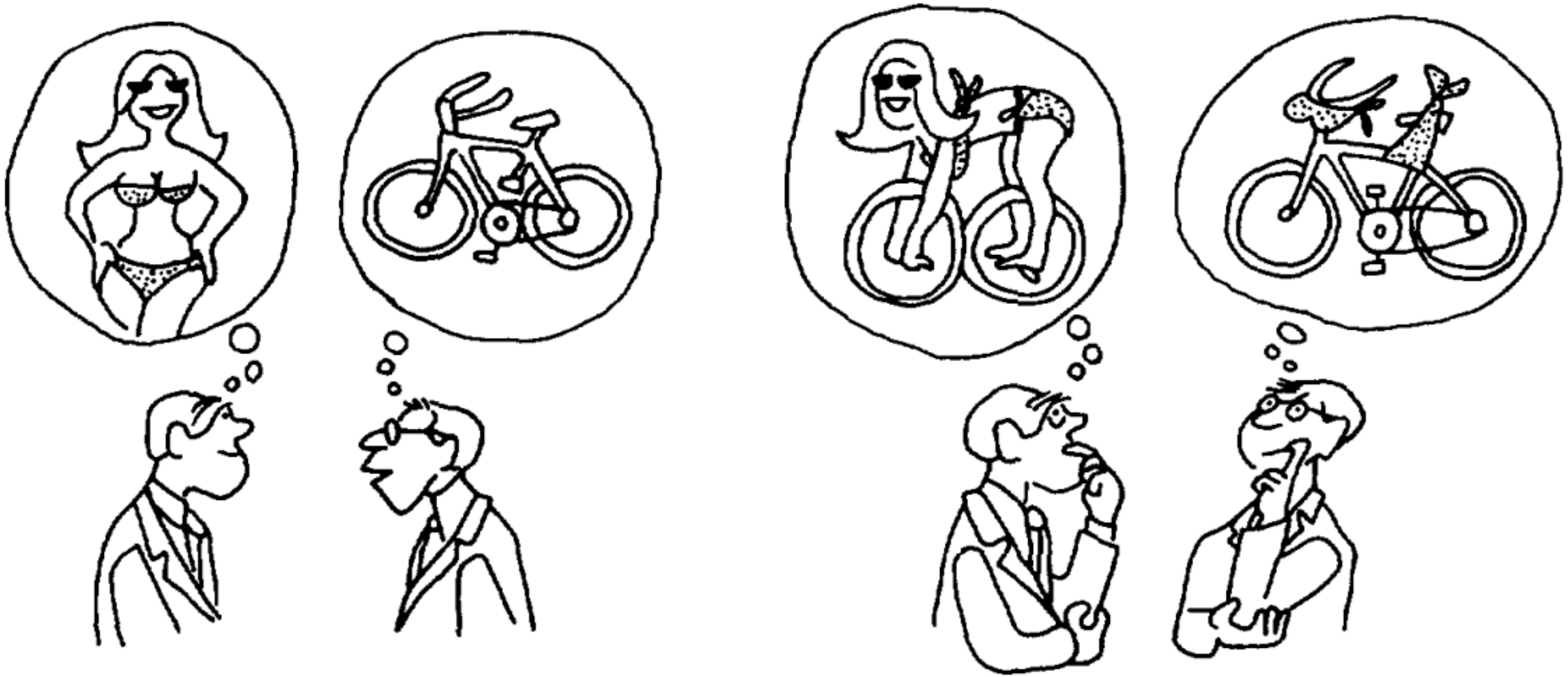
“The computer—switch or interactor?”

“Distributed intellectual resources”

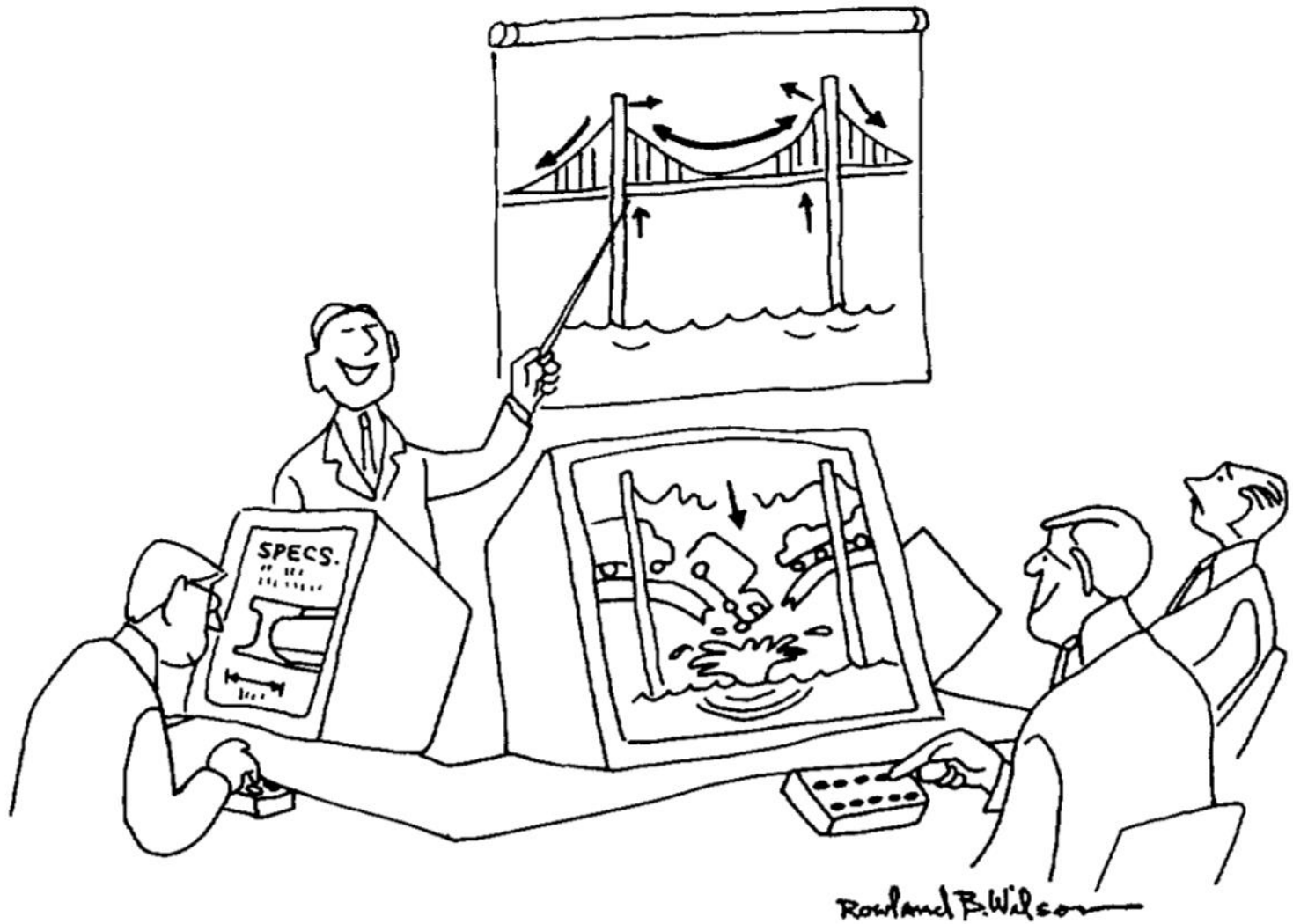
“Computer and information networks”

“Message processing”

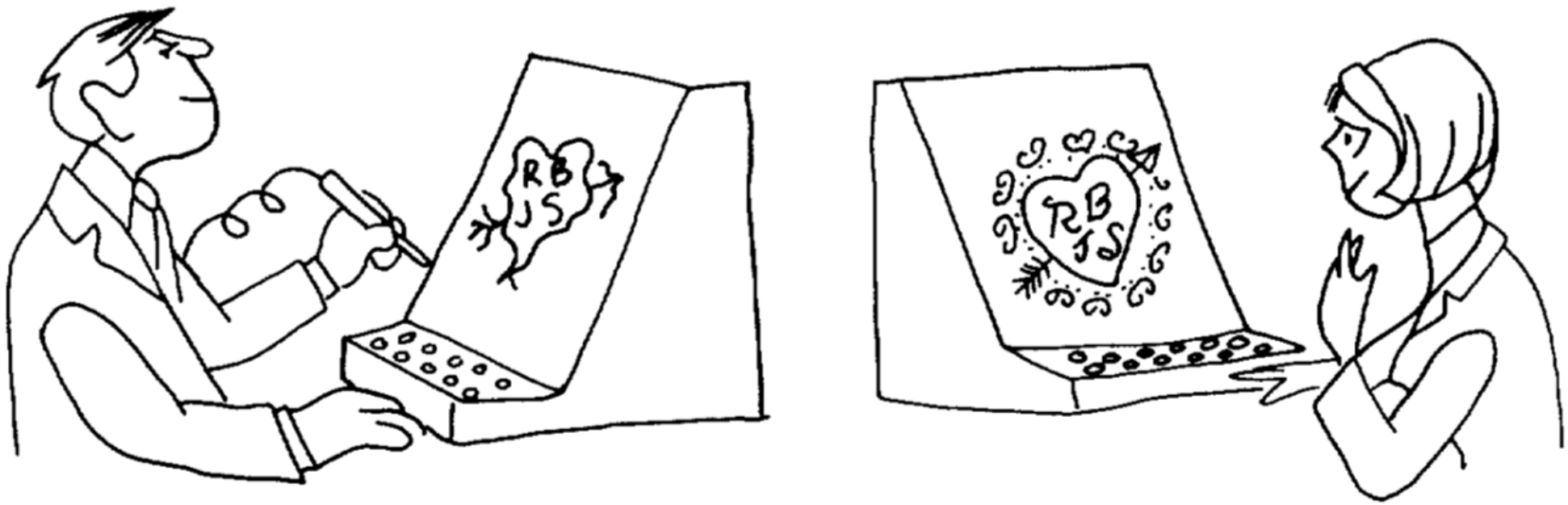
“On-line interactive communities”



When mental models are dissimilar, the achievement of communication might be signaled by changes in the structure of one of the models, or both of them.

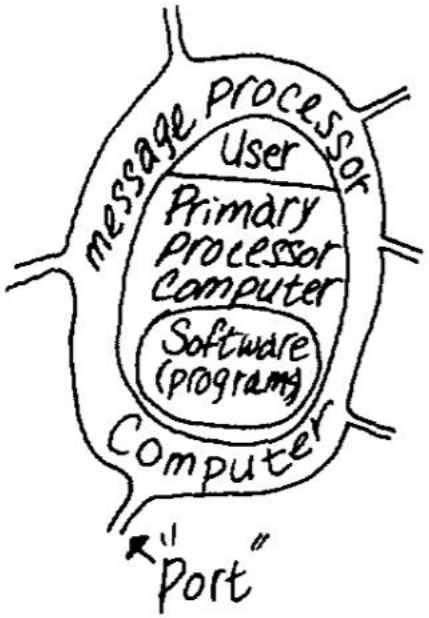


At a project meeting held through a computer, you can thumb through the speaker's primary data without interrupting him to substantiate or explain.

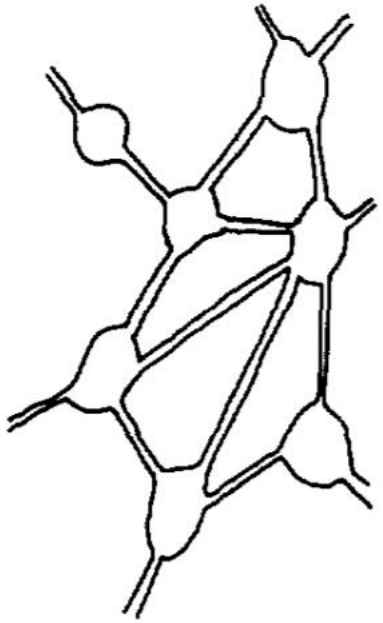


A communication system should make a positive contribution to the discovery and arousal of interests.

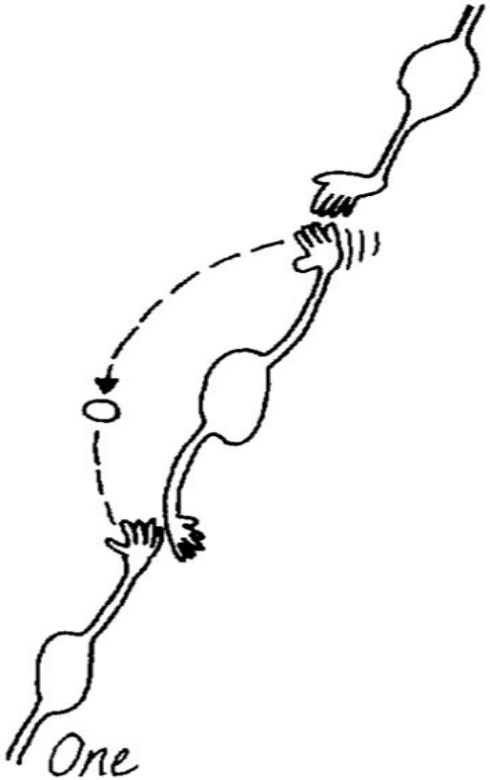
What's in a Node?



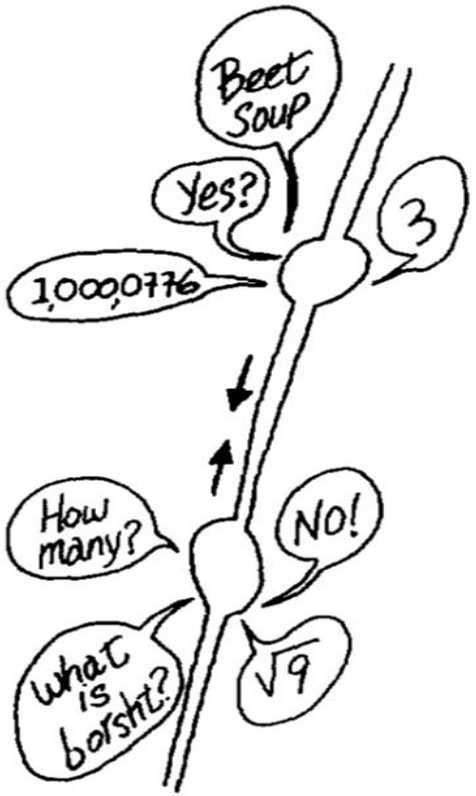
* Operating Syste
Graphic display
Interpreter
User Programs
Files, etc.



All nodes can be interconnected via their message processors



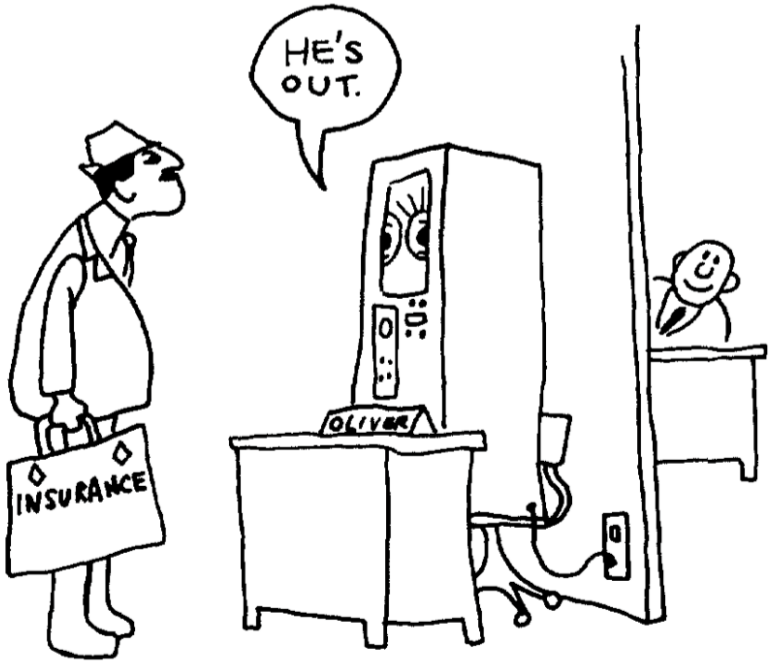
One Message processor can be the messenger between two other message processors



A given, pair of nodes may exchange several independent messages for simultaneous users with different interests.

“You will not send a letter or a telegram; you will simply identify the people whose files should be linked to yours and the parts to which they should be linked-and perhaps specify a coefficient of urgency. You will seldom make a telephone call; you will ask the network to link your consoles together.”

Meet
OLIVER



Your computer will know who is prestigious in your eyes and buffer you from a demanding world.

“On-Line Interactive Vicarious Expediter & Responder”

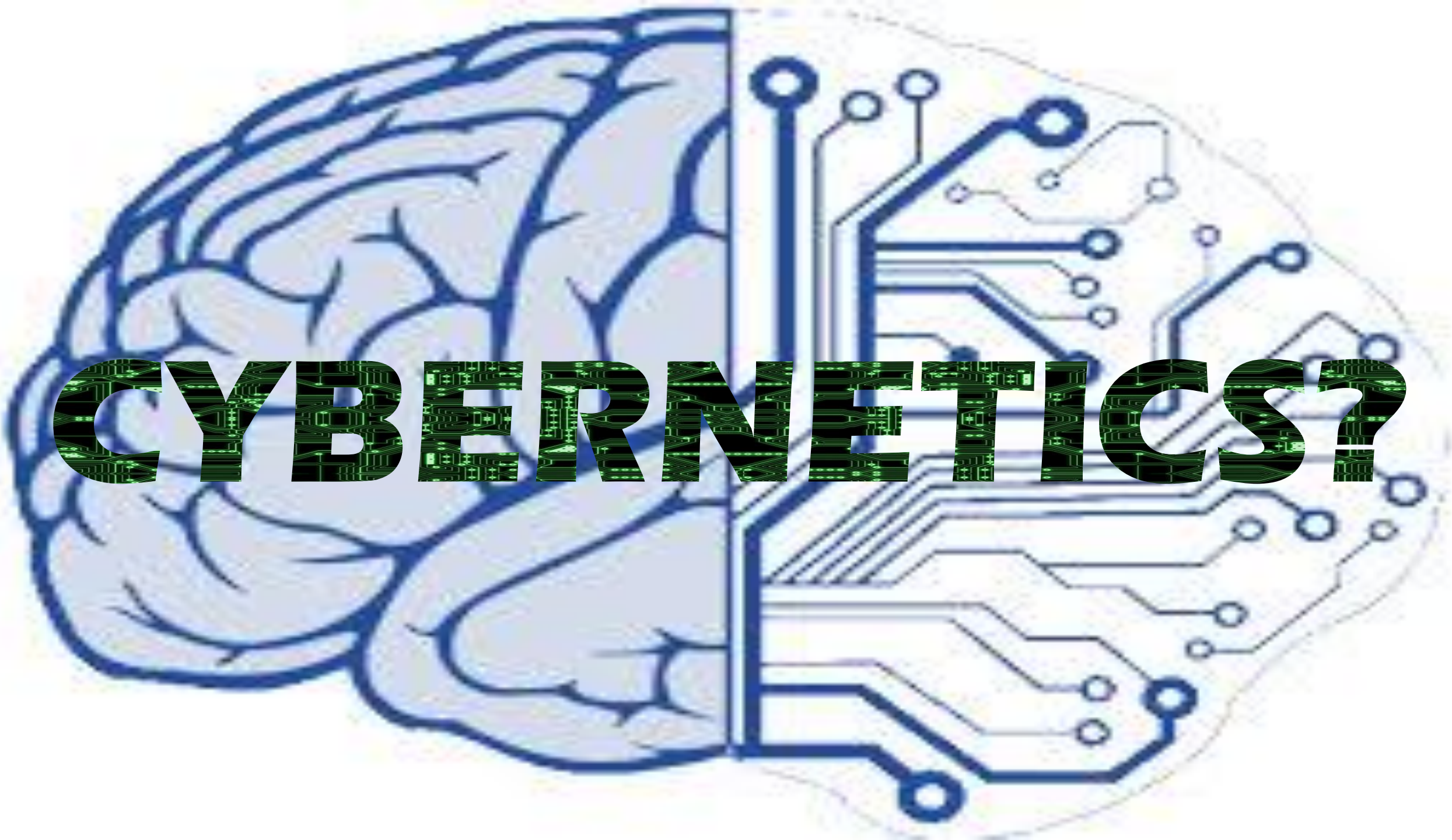
“ … a complex of computer programs and data that resides within the network and acts on behalf of its principal, taking care of many minor matters that do not require his personal attention and buffering him from the demanding world. “You are describing a secretary,” you will say. But no! Secretaries will have OLIVERS.

At your command, your OLIVER will take notes (or refrain from taking notes) on what you do, what you read, what you buy and where you buy it. It will know who your friends are, your mere acquaintances. It will know your value structure, who is prestigious in your eyes, for whom you will do what with what priority, and who can have access to which of your personal files. It will know your organization’s rules pertaining to proprietary information and the government’s rules relating to security classification.”

Oliver Selfridge

Graduate student
of
Norbert Wiener

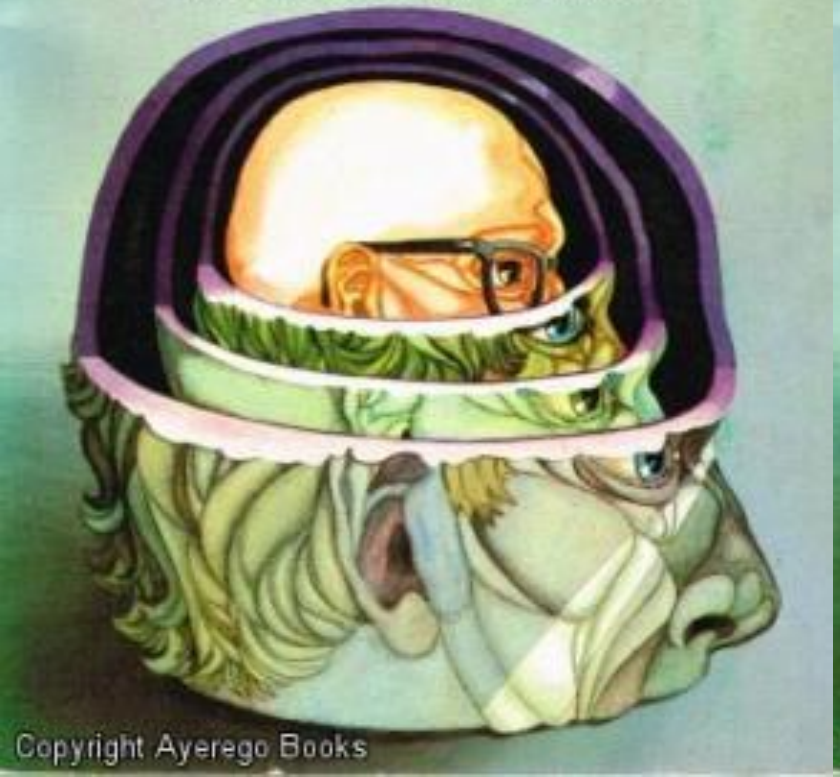
Early reviewer
of
“Cybernetics”


CYBERNETICS?

NORBERT WIENER

THE HUMAN USE OF HUMAN BEINGS

The most influential work on man's role in an automated world, by the founder of the science of cybernetics.



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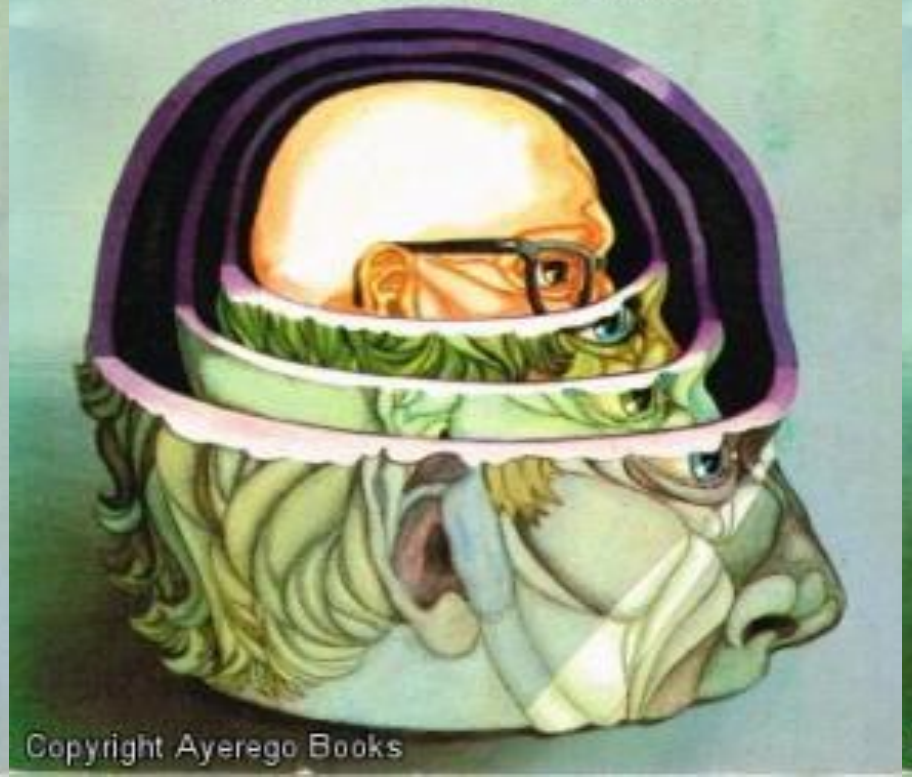

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“We are the slaves of our technical improvement and we can no more return a New Hampshire farm to the self-contained state in which it was maintained in 1800 than we can, by taking thought, add a cubit to our stature.”

“We have modified our environment so radically that we must now modify ourselves in order to exist in this new environment. We can no longer live in the old one.”

Jack Good joined Bletchley Park in 1941, where he worked first on Enigma and then on Tunny, becoming principal statistician in the Newmanry. After the war he was offered a lectureship in mathematics at the University of Manchester but in 1948 returned to codebreaking at Bletchley Park's peacetime successor, GCHQ. In 1967 he left England for Virginia Polytechnic Institute where he spent the rest of his life, initially as Research Professor of Statistics and from 2004 as Emeritus University Distinguished Professor. Good's books include *Probability and the Weighing of Evidence* and *Good Thinking: The Foundations of Probability and its Applications*. He died in 2009.

"Speculations Concerning the First Ultraintelligent Machine"

I. J. Good

"Advances in Computers", vol. 6, 1965

Speculations Concerning the First Ultraintelligent Machine*

IRVING JOHN GOOD

Trinity College, Oxford, England and
Atlas Computer Laboratory, Chilton, Berkshire, England

1. Introduction

The survival of man depends on the early construction of an ultra-intelligent machine.

In order to design an ultraintelligent machine we need to understand more about the human brain or human thought or both. In the following pages an attempt is made to take more of the magic out of the brain by means of a "subassembly" theory, which is a modification of Hebb's famous speculative cell-assembly theory. My belief is that the first ultraintelligent machine is most likely to incorporate vast artificial neural circuitry, and that its behavior will be partly explicable in terms of the subassembly theory. Later machines will all be designed by ultra-

"The survival of man depends on the early construction of an ultra-intelligent machine.

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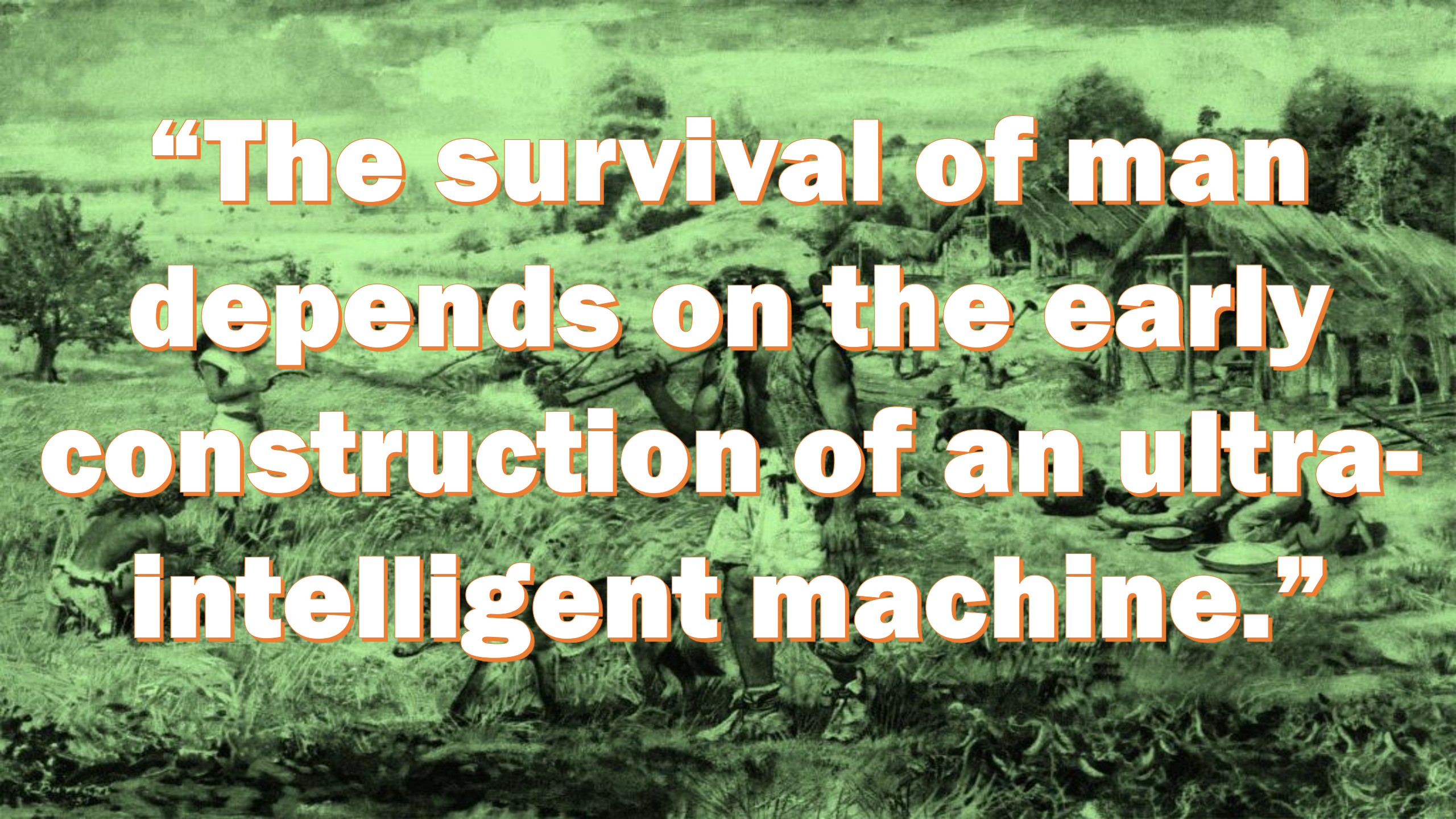
THE INTELIGENCE EXPLOSION

“Let an ultraintelligent machine be defined as a machine that can far surpass all the intellectual activities of any man however clever. Since the design of machines is one of these intellectual activities, an ultraintelligent machine could design even better machines; there would then unquestionably be an 'intelligence explosion,' and the intelligence of man would be left far behind. Thus the first ultraintelligent machine is the last invention that man need ever make, provided that the machine is docile enough to tell us how to keep it under control.”


“The survival of man depends on the early construction of an ultra-intelligent machine.”