ARTICLE

The "General Problem Solver" Does Not Exist: Mortimer Taube and the Art of AI Criticism

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This article reconfigures the history of artificial intelligence (AI) and its accompanying tradition of criticism by excavating the work of Mortimer Taube, a pioneer in information and library sciences, whose magnum opus,* Computers and Common Sense: The Myth of Thinking Machines *(1961), has been mostly forgotten. To convey the essence of his distinctive critique, the article focuses on Taube's attack on the general problem solver (GPS), the second major AI program. After examining his analysis of the social construction of this and other "thinking machines," it concludes that, despite technical changes in AI, much of Taube's criticism remains relevant today. Moreover, his status as an "information processing" insider who criticized AI on behalf of the public good challenges the boundaries and focus of most critiques of AI from the past half-century. In sum, Taube's work offers an alternative model from which contemporary AI workers and critics can learn much.

EXPOSED

I discovered Mortimer Taube in a footnote to the penultimate chapter of *Computers and Thought* (1963), the first collected volume of articles in the nascent field of "artificial intelligence" (AI).[1] The chapter, "Attitudes toward Intelligent Machines," by Paul Armer, then head of the Computer Sciences Department of the RAND Corporation, is a partisan consideration of the social aspects of AI. Armer hoped to "improve the climate which surrounds research in the field of machine or artificial intelligence" by convincing skeptics "that they should be tolerant" of research questions such as, "Can machines think?" Noting the "negative attitudes existent today tend to inhibit such research," his first footnote warns the reader:

> *ALMOST AN ENTIRE BOOK,* COMPUTERS AND COMMON SENSE, THE MYTH OF THINKING MACHINES, *HAS BEEN DEVOTED TO CONDEMNING ARTIFICIAL INTELLIGENCE RESEARCH (TAUBE, 1961). READERS WHO HAVE BEEN EXPOSED TO THIS BOOK SHOULD REFER TO REVIEWS OF IT BY RICHARD LAING (1962) AND WALTER R. REITMAN (1962), PARTICULARLY THE FORMER.*[2]

Placed prominently on the first page, this footnote raised several questions: Who was this Mortimer Taube? And what was in his book, such that it could so disturb Armer, a noted scion of the military-industrial complex? Furthermore, what had Laing and Reitman said in their rebuttals? Had they succeeded in curing readers who'd been "exposed" to Taube? And could that be why I, despite being fairly familiar with the history of AI,[3] had never heard of him?

This article answers these questions. It begins by showing how Taube's career in library and information sciences informed his views on AI. Though his critique ranged widely, targeting everything from the philosophy of machine intelligence to the political economy of automated defense systems, I illustrate Taube's distinctive critical approach by delving into his attack on the General Problem Solver (GPS). After the Logic Theorist, GPS is regarded as the second major AI program, both developed by Herbert Simon

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and Alan Newell in collaboration with their programmer, J. C. Shaw.[4]

If, despite its current popularity, the history of AI remains underdeveloped, having been largely written by practitioners and insiders themselves,[5] then the history of AI criticism is all the more inadequate. Internalist accounts typically point to one of two UC Berkeley professors of philosophy: Hubert Dreyfus, and/or John Searle.[6] More nuanced treatments may mention AI defectors such as Joseph Weizenbaum, Terry Winograd, or Phillip Agre, and perhaps social scientists such as Lucy Suchman or Harry Collins.[7] Taube, however, "who, besides being an outstanding theorist and inventor, [was] one of the most successful business practitioners of the computer-based, data-processing art,"[8] is nowhere to be found.[9]

By exposing the reader to Taube's work, this article contributes a forgotten episode to the history of "AI and its Discontents"[10] that reconfigures the tradition of AI criticism by rediscovering its foundation *within* the technical boundaries of the field. Whereas the philosophers, defectors, and social scientists are typically regarded as outsiders, the same cannot be said of Taube, whose insights remain relevant over a half-century later.

WHO WAS MORTIMER TAUBE?

In addition to being a trained philosopher,[11] Taube was a mid-century pioneer in the burgeoning field of "documentation," a term he proposed[12] to describe the "activities at the forward edge of the parent profession, library science."[13] Central to documentation was "information storage and retrieval," the precomputer study of mechanized systems for indexing, storing, searching, and retrieving information. Antecedent to and distinct from the computer-based paradigm of "information processing"[14] (within which it was eventually subsumed), information retrieval was a major area of interest and activity within the American bureaucracies of the post-WWII military-industrial-university complex. Taube, who founded Documentation Inc. in 1951 to supply information retrieval systems to the US Department of Defense and other government agencies, is ranked alongside Shannon and Boole for his fundamental contributions to the field.[15]

Born in Jersey City, 1910, Taube received his doctorate in philosophy from the University of California before entering library science. After working in several university libraries, he served as the Director of several research divisions of the Library of Congress throughout the 1940s and 1950s. In this and other eminent government positions, Taube bridged technical and social approaches to information. He believed library science had calcified in its confidence that "the basic problem of cataloging and classification had been resolved" by "the giants of our profession," such as Dewey, yet was being challenged by information retrieval, a new field "dominated by engineers, chemists, computer specialists, and other groups most interested in information but also most disdainful of the tradition of professional librarianship."[16] Working to resolve this tension shaped Taube's conception of the role machines ought to play in social life. In contrast to others' uncritical enthusiasm for them, he regarded computers as unproven yet potentially useful tools for augmenting the human intellect.

Following WWII, rapid growth in the annual production of scientific and technical information was straining libraries.[17] Entirely new technoscientific fields were opening up, generating novel categories of knowledge. How to manage it all? What systems would allow decision makers and researchers to leverage this information, rather than be buried under it? Traditional techniques for cataloging and indexing were insufficient. New methods of information retrieval were needed. Yet barriers stood in the way.[18]

Many technical experts argued these barriers were human. At the Royal Society's conference on Scientific Information in 1948, the working party on mechanical indexing argued that computer technologies capable of solving the problem existed but were not being adopted by librarians. Their recalcitrance was slowing progress. Taube, representing the Library of Congress, disagreed.[19] Computers were not being adopted, he averred, because their superiority to extant systems remained to be demonstrated.[20] Numerical calculation, at which computers excel, was a costly form of information processing not necessarily adapted to the nonnumerical problems of storage and retrieval. Taube would solve the problem himself.

Coordinate Indexing

While Acting Chief of the Technical Information Branch of the Atomic Energy Commission, Taube, proposing "to 'set a thief to catch a thief'; 'to kill a toxin with an anti-toxin'; 'to master the machine with a machine',"[21] developed an alternative system for electromechanical information retrieval. A survey of extant mechanized systems—"edge-notched cards; the Batten system; Hollerith and Power-Samas punched card systems; the Samian punched card system; the Rapid Selector; the Univac; Zatocoding; and the combination of punched cards and

microphotography"—revealed their limitations were conceptual, rather than mechanical.[22] What was needed was not a "Giant Brain"[23] capable of rapid calculation, but "a machine which will add the idea of steel with the idea of sphere and give the product, 'steel ball.'"[24] This would allow for information retrieval via the "association of ideas,"[25] an approach inspired by Vannevar Bush's classic essay, "As We May Think."[26] Taube's insight led to the technique (and later theory) of "coordinate indexing," first presented in 1951 to the Division of Chemical Literature of the American Chemical Society, the most active area of documentation research at the time.[27]

As "a general theory describing a method of organizing categories of information into index terms,"[28] coordinate indexing is regarded as a foundational advance in library and information sciences.[29] The main idea is simple. Once indexed with individual terms representing single ideas, or "uniterms," documents can be efficiently organized, stored, searched, and retrieved using combinations of Boolean logic.[30] By exploiting combinatorics, coordinate indexing allowed a vast quantity of information to be economically indexed with a modicum of uniterms.[31]

What distinguished Taube's approach to information retrieval from contemporaneous work in information processing was that his system utilized the second-order logic of predicates on classes, or "class calculus," rather than the first-order propositional calculus used in computers of the time. As one reviewer observed, this difference followed from the fact that his system was designed to augment the human intellect as is, rather than require the adoption of altogether new methods to exploit the calculative power of the new machines:

> *MORTIMER TAUBE POINTED OUT THAT A HUMAN BEING, IN MAKING A SEARCH, MATCHES WHAT HE SEES WITH THE QUESTION IN HIS MIND. HE RECOGNIZES THINGS BY ANALOGY. A MACHINE DOES NOT RECOGNIZE BY ANALOGY BUT BY EXACT MATCH. A COMPUTER, THEREFORE, CAN BE 'DESCRIBED IN TERMS OF A PROPOSITIONAL CALCULUS OR LOGIC (THAT IS, YES OR NO TO A SERIES OF PROPOSITIONS). ON THE OTHER HAND, A STORAGE AND RETRIEVAL DEVICE, IF IT IS TO SEARCH FOR INFORMATION ON A SUBJECT OR CLASS BASIS, WOULD HAVE TO BE DESCRIBED BY A CLASS CALCULUS.[32]*

The first customer for Taube's information retrieval systems based on coordinate indexing was the US Air Force Armed Services Technical Information Agency. On this contract, Documentation Inc. performed "the first subject search ever made by digital computer."[33] As more contracts with Cold War-era government agencies followed, Taube and his associates refined coordinate indexing, the uniterm system, and their information retrieval machines throughout the 1950s and mid-1960s.[34] By putting his theories into practice, Taube developed technical expertise in the design and manufacture of information processing machines, as well as industry experience in the procurement and fulfillment of large-scale government contracts.

Yet Taube remained a philosopher and librarian, and in response to his peers' credulous embrace of computers as solutions for social problems, became a tenacious critic of computing. Building machines to aid decision makers and knowledge workers in government and academe was central to his humanist agenda. For millennia, the library has been society's primary site of "information processing"—understood as research, study, scholarship, and human inquiry. From quills on parchment to card catalogs and microfilm, the library has always been augmented by "information technology."[35] Taube's machines were an extension of this tradition, oriented to the needs of enquiring human minds rather than the technical affordances of digital computers *per se*. In contrast to Norbert Wiener's warnings about a Second Industrial Revolution in which machines replaced mental labor,[36] for Taube, minds and machines ought to participate in a clear division of labor: Computers were to augment, rather than simulate, automate, or otherwise reproduce the human intellect.

WHAT WAS IN THAT BOOK?

Whereas Dreyfus, Searle, and other critics were regarded as outsiders intruding on AI, the same could not be said of Taube, who was designing and manufacturing functional information retrieval machines for the very government agencies that later funded the AI enterprise when the legendary Dartmouth Conference was still just a proposal.[37] Yet while the AI pioneers made no reference to library science, information retrieval, or

documentation in their literature, Taube recognized that their "information processing" model of the mind[38] threatened all three.

> *FOR A NUMBER OF YEARS MY COLLEAGUES AND I HAVE BEEN ENGAGED IN THE DEVELOPMENT OF A MECHANIZED DATA PROCESSING CENTER FOR SCIENTIFIC AND TECHNICAL INFORMATION. AS WE WORKED TO SOLVE PROBLEM AFTER PROBLEM, AS WE DESIGNED METHODS FOR CONVERTING RAW, FORMLESS DATA INTO MACHINE-PROCESSABLE FORM, AS AGAIN AND AGAIN WE RAN INTO MACHINE LIMITATIONS, AND HUMAN INABILITY TO FORMALIZE INTENTIONS AND MEANINGS COMPLETELY, WE WERE DIMLY AWARE THAT OUTSIDE OUR OWN NARROW LABORS, A LITERATURE WAS BEING DEVELOPED ABOUT NEW TYPES OF MACHINES WHICH WOULD, IF THEY EXISTED, MAKE ALL OUR WORK OBSOLETE.*[39]

Noting that "This type of technological obsolescence has occurred before and will occur again," Taube wondered: Had researchers in AI succeeded where he only muddled through? In 1960, J. C. R. Licklider announced "There are, in fact, several theorem-proving, problem-solving, chess-playing, and pattern-recognizing programs. . .capable of rivaling human intellectual performance in restricted areas; and Newell, Simon, and Shaw's 'general problem solver' may remove some of the restrictions."[40] Interest piqued, Taube set out to investigate.

Computers and Common Sense, The Myth of Thinking Machines (1961) was the result. In it, Taube reviewed the AI literature to consider the "evidence for the existence and possible existence at some future time" of machines whose creators claimed can "translate languages, learn in just the same sense as a human learns, make decisions, and, in short, carry out any intelligent operation that a human being is capable of carrying out."[41]

Cognitive Simulation via "Thinking Machines"

AI pioneers Herbert Simon and Alan Newell often made such grandiose claims. Announcing their Logic Theorist program in 1956, Simon casually informed his students, "Over Christmas Allen Newell and I invented a thinking machine."[42] In fact, the "machine" was only a "program" they "executed" on their assembled family members, who used notecards to act out its instructions.[43] Soon after, collaboration with the programmer J. C. Shaw at RAND led them to claim that "there are now in the world machines that think, that learn, and that create

> *MOREOVER, THEIR ABILITY TO DO THESE THINGS IS GOING TO INCREASE RAPIDLY UNTIL—IN A VISIBLE FUTURE—THE RANGE OF PROBLEMS THEY CAN HANDLE WILL BE COEXTENSIVE WITH THE RANGE TO WHICH THE HUMAN MIND HAS BEEN APPLIED.*[44]

Undeterred by colleagues' consternation at such "majestic"—though unscientific—prognostications,[45] they baked this stately ambition into the name of their next AI program, the "General Problem Solver" (GPS).

When debuted in a 1959 RAND whitepaper, Simon and Newell described the GPS modestly as "an attempt to fit the recorded behavior of college students trying to discover proofs." Their purpose in building it was "not to relate the program to human behavior, but to describe its main characteristics and to assess its capacities as a problem-solving mechanism."[46] Yet in a later *Science* article, "Computer Simulation of Human Thinking," they concluded that the GPS "is a computer program that is capable of simulating, in first approximation, human behavior in a narrow but significant problem domain."[47] Finally, in a chapter for *Computers and Thought* entitled "GPS, A Program That Simulates Human Thought," Simon and Newell were confident enough to be coy:

> *IT IS OFTEN ARGUED THAT A CAREFUL LINE MUST BE DRAWN BETWEEN THE ATTEMPT TO* ACCOMPLISH *WITH MACHINES THE SAME TASKS THAT*

> *HUMANS PERFORM, AND THE ATTEMPT TO* SIMULATE *THE PROCESSES HUMANS ACTUALLY USE TO ACCOMPLISH THESE TASKS. THE PROGRAM DISCUSSED IN THE REPORT, GPS (GENERAL PROBLEM SOLVER), MAXIMALLY CONFUSES THE TWO APPROACHES—WITH MUTUAL-BENEFIT.*[48]

Ironically, this statement summarized their view of cognition as information processing—what Dreyfus called the "cognitive simulation" paradigm of AI.[49] Breaking with Turing's agnostic view of intelligence as whatever fools the judge,[50] Simon and Newell asserted the GPS simulated thought and behavior using the *same* cognitive processes as humans—that mind and machine are both *information processors*.[51]

"Fraud by Computer"

Did these and other papers demonstrate a new class of machines capable of making Taube and associates' work at Documentation Inc. obsolete? Responding to Simon and Newell's 1961 article, Taube wrote to *Science* that they indicated something else entirely: circular reasoning. That is, they described the mind as a computer, then "discovered" that it could be simulated by computer. For Taube, this amounted to "what the editor of Scientific American has called "fraud by computer":

> *CERTAINLY A COMPUTER CAN SIMULATE HUMAN THINKING IF THE WORD* SIMULATION *IS DEFINED AS WEBSTER HAS DEFINED IT: "1. ACT OF SIMULATING OR ASSUMING AN APPEARANCE WHICH IS FEIGNED, OR NOT TRUE; PRETENSE OR PROFESSION MEANT TO DECEIVE. 2. ASSUMPTION OF A SUPERFICIAL SEMBLANCE, A COUNTERFEIT DISPLAY."*[52]

Rather than respond to the content of Taube's critique, however, Simon and Newell took issue with his style: "In view of his abusive tone, we think it fruitless to enter into discussion with him."[53] As we shall see, Taube's targets often adopted this ploy, not entirely without reason.

In *Computers and Common Sense,* Taube characterized AI as an elaborate, pseudoscientific façade, buoyed on taxpayer-funded government grants administered by unaccountable military officials and shielded from scrutiny by a novel publication system not subject to established standards of peer review. Moreover, his investigation concluded that the machines capable of performing the tasks their creators claimed for them simply did not exist.

How was this possible? Years before "social construction" became a term of art in the criticism of science and technology,[54] Taube described how AI pioneers affected the reality of "thinking machines" through the clever use of language:

> *. . .ALL THE GREAT MECHANICAL BRAINS, TRANSLATING MACHINES, LEARNING-MACHINES, CHESS-PLAYING MACHINES, PERCEIVING MACHINES, ETC., ACCOUNTS OF WHICH FILL OUR PRESS, OWE THEIR "REALITY"* TO A FAILURE TO USE THE SUBJUNCTIVE MOOD. *THE GAME IS PLAYED AS FOLLOWS: FIRST, IT IS ASSERTED THAT EXCEPT FOR TRIVIAL ENGINEERING DETAILS, A PROGRAM FOR A MACHINE IS EQUIVALENT TO A MACHINE. THE FLOW CHART FOR A PROGRAM IS EQUATED TO A PROGRAM. AND FINALLY, THE STATEMENT THAT A FLOW CHART COULD BE WRITTEN FOR A NONEXISTENT PROGRAM FOR A NONEXISTENT MACHINE ESTABLISHES THE EXISTENCE OF THE MACHINE. IN JUST THIS WAY . . . SIMON, SHAW, AND NEWELL'S "GENERAL PROBLEM SOLVER," AND MANY OTHER NONEXISTENT DEVICES HAVE BEEN NAMED IN THE LITERATURE AND ARE REFERRED TO AS THOUGH THEY EXISTED.*[55]

A similar game is often played today in claims that AI is solving humanity's biggest problems.[56]

How could an entire literature have been generated about nonexistent machines? Taube explained by way of analogy to Carter and Pollard's infamous 1934 *Enquiry into the Nature of Certain Nineteenth Century Pamphlets*.[57] It described the discovery of the largest literary forging operations to date, implicating literary experts and the esteemed institutions that employed them as complicit in the fraud. How did it work? Social authority and institutional capital protected the culprits from scrutiny while an elaborate network of peer-citation provided a scientific imprimatur to the supposedly authentic artifacts.

> *ONE OF THE THINGS THAT CARTER AND POLLARD DISCOVERED WAS THAT WHOLE STRUCTURES OF LITERARY COMMENT WERE BASED UPON A SINGLE SENTENCE, REPEATED AND ELABORATED UPON BY MANY DIFFERENT PEOPLE. WHAT LOOKED TO BE A GREAT MASS OF EVIDENCE FOR THE AUTHENTICITY OF THE FORGERIES WAS ALL TRACEABLE TO A QUOTING B, WHO HAD QUOTED C, WHO HAD QUOTED D, WHO HAD QUOTED E, ETC. SIMILARLY, IT HAS BEEN SHOWN THAT WITH REFERENCE TO SCIENTIFIC ACTIVITIES EXAMINED IN THIS STUDY, WHAT LOOKS TO BE A GREAT MASS OF SERIOUS, DETAILED WORK CARRIED OUT BY SCIENTISTS OF DISTINGUISHED REPUTATION EVAPORATES WHEN EXAMINED WITHOUT PREJUDICE.*[58]

As with literary forgeries, so too with "thinking machines." Often dismissed as mere "hype" today, the "promissory rhetoric"[59] of AI began as a means of concealing a sophisticated scam, not unlike "the behavior of the tailors in 'The Emperor's New Clothes.'"[60]

Yet Taube did not accuse the AI pioneers of fraud *per se*. He distinguished them from simple criminals by noting that while the forgers were ostensibly aware that they were committing fraud, the creators of "thinking machines" actually believed they were doing science.

AI as Scientific Aberration

The science of AI is premised on what Taube called the "Man-Machine Identity": in the words of one AI pioneer the human being is nothing but a "meat machine"—albeit a complicated one. Therefore, "the simulation of human brains by machines can be interpreted as the simulation of a machine by a machine,"[61] an operation that is not logically impossible, however improbable, costly, or undesirable. It was at this form of reasoning that Taube leveled his most damning charge: The defense of a research program on the grounds that it is not logically impossible is the hallmark not of Science—but of "scientific aberrations": astrology and phrenology, rather than astronomy or physiology.[62] Just as charlatans claim it is not logically impossible for planetary movements or cranial protuberances to determine human behavior, AI advocates claim it is not logically impossible for machines to simulate cognition.

Consider, for example, Feigenbaum and Feldman's assertions in *Computers and Thought*:

> *WHAT IS IMPORTANT IS THAT WE CONTINUE TO STRIKE OUT IN THE DIRECTION OF THE MILESTONE THAT REPRESENTS THE CAPABILITIES OF HUMAN INTELLIGENCE. IS THERE ANY REASON TO SUPPOSE THAT WE SHALL NEVER GET THERE? NONE WHATEVER. NOT A SINGLE PIECE OF EVIDENCE, NO LOGICAL ARGUMENT, NO PROOF OR THEOREM HAS EVER BEEN ADVANCED WHICH DEMONSTRATES AN INSURMOUNTABLE HURDLE. . .*[63]

But as Taube observed in another context, "When reputable scientists begin to accept explanations merely on the basis that they *could* be true and that nothing *forbids* their being true, science becomes indistinguishable from superstition,"[64] because no amount of negative evidence is ever sufficient to convince its adherents to reconsider. This argument from nonimpossibility thus conceals an ideological faith in the AI enterprise inappropriate to scientific inquiry—a faith unshaken by the near-total collapse of the AI enterprise twice in the 20th century,[65] and one readers will have no difficulty identifying in contemporary AI literature.

Taube's excoriation of AI as a "scientific aberration" equivalent to astrology anticipated Dreyfus' better-known critique of AI as "alchemy" by several years.[66] Like Darwin and Wallace, they appear to have arrived at similar conclusions independently.[67] Whereas Dreyfus stayed firmly on philosophical territory, however, Taube connected his critique to the actual and potential socioeconomic consequences of such unscientific rhetoric. For example:

> *THE STATEMENT THAT MAN IS "NOTHING BUT" A DIGITAL COMPUTER MAY BE NOT ONLY BAD METAPHYSICS AND OF DUBIOUS SCIENTIFIC OR HEURISTIC VALIDITY, BUT ALSO MAY BE DANGEROUSLY FALSE. THIS IS SO BECAUSE TODAY SUCH STATEMENTS ARE INTENDED FOR MORE THAN PHILOSOPHIC OR SCIENTIFIC DEBATE. THEY ARE MADE TO INFLUENCE THE ALLOCATION OF RESEARCH FUNDS AND DEFENSE BUDGETS AND TO GUIDE DEFENSE PLANNING. HENCE, THEIR UNCRITICAL ACCEPTANCE CAN LEAD TO CATASTROPHE.*[68]

Writing at the height of the early Cold War, his concerns about catastrophic outcomes applied not only to lives lost, but also to dollars wasted.

Taube uncovered a catastrophe of the latter sort in "mechanical translation" (MT). Initiated immediately after WWII, MT was arguably the earliest form of what would later be called AI.[69] With over a decade of government funding at approximately $3 million per annum—a sum sufficient to "run a medium-sized university" or "hire 300 full-time translators at $10 000 per year"—Taube's discovery that "no practical, usable MT program exists" led him to consider it an enormous failure.[70] Yet he recognized that a now-common rhetorical ploy was already being used "to justify this waste of funds": MT researchers claimed some good might come out of it.[71]

Because the costs of AI research and development had evaded scrutiny prior to Taube, these and other socioeconomic evaluations constituted some his most dangerous criticisms. And for these heresies, Taube drew the ire of the Artificial Intelligentsia.[72]

WHAT DID THE REVIEWERS SAY?

Recall Armer's advice to those "exposed" to Taube: take refuge in the reviews by Laing and Reitman. Let us consider each in turn.

Laing, "Book Review" (1962)

In a review for *Behavioral Science,* Richard Laing, a researcher in the Logic of Computers Group at the University of Michigan, fairly assessed Taube's aims—"Taube feels that pseudoscience disguised as legitimate research will undoubtedly continue to be supported and may even proliferate despite the complete futility of its goals"—before condemning the book for its "scores of misrepresentations, fallacies in reasoning, ignorance of fact and of usage, as well as the numerous gratuitous insults." As for what those were, exactly, Laing does not deign to say, for "the reader, should he choose to open the book, will readily note these for himself."[73]

Laing claimed Taube relied on Gödel's incompleteness and Heisenberg's uncertainty to undermine the possibility of computerized cognitive simulation. That is, if formal systems are incomplete and uncertain, then the human mind—itself obviously capable of discovering those properties—cannot be a formal system; ergo, computers cannot simulate cognition, and AI is impossible. Misapplying physics to biology in this way, Laing argued, was a simple category error. A powerful argument—if it were not a strawman. Intentionally or not, Laing misrepresented Taube, who used incompleteness and uncertainty only as analogies to illustrate his arguments, which instead relied on human sciences—psychology, economics, philosophy—as well as his own expertise in information processing. Furthermore, Laing's conclusion—that "there do not appear to be any rigorous arguments against the possibility of computers doing things typical of human intelligence"[74]—revealed he had failed to grasp Taube's central point about the logic of nonimpossibility and the scientific aberration called AI.

Reitman, "Fact or Fancy?" (1962)

Writing from the Graduate School of Industrial Administration at Carnegie Institute of Technology (which, as Taube warily noted, employed both Simon and Newell at the time[75]), Walter R. Reitman, an Assistant Professor of industrial administration and psychology, as well as a staunch advocate of the "information processing" model of mind,[76] began his *Science* review with an *ad hominem* attack: "This book is the work of an angry man."[77] Reitman argued the book "consists of allegations presented as facts, of misunderstandings, of

debaters' tricks identical to those he decries in others, and of statements about the work of others which are simply untrue." Worse, Taube "simply denies or ignores the existence of facts that contradict his case"—such as Simon and Newell's GPS. For nonbelievers, Reitman offered his own good word as an existence proof: "I spent several weeks 2 years ago studying listings from the General Problem Solver, and thus I can testify that it does in fact exist, even as you and I."[78]

This was apparently sufficient proof for some philosophers.[79] Taube, however, retorted that "Since 'you and I' certainly exist as something other than a program in a general-purpose computer (or the mind of God), the question, 'Whose statements are untrue?' resolves itself." To drive home his point, he requested the strongest existence proof possible in capitalist America: "we are prepared to buy a general problem solving machine and are most anxious to secure the franchise for Washington, which we think needs such machines very much," adding that he hopes Reitman "can quote us a price and delivery date." Reitman responded that the GPS exists in exactly the same sense in which all the "programs of the business world exist—as sets of instructions for general-purpose digital computers." Unable to complete the entreated sale, he instead quipped that "If Taube wants his own GPS, he has only to request the program from Newell, Shaw, or Simon, rent time on an IBM 7090, and run to his heart's content."[80]

This exchange over the existence of the GPS shows what was at stake in early AI. Reitman was defending a *program*—a set of instructions that could be implemented by hand on paper (as was common at the time), on a general-purpose computer, or by a family on holiday. The GPS existed because the program had been implemented, and Reitman knew this because he had seen "traces" of its output. Whether the program actually solved general problems as claimed was not his concern.

For Taube, however, it was not that Reitman's word was no good, nor that "traces" of the GPS were insufficient proof of its existence. Rather, as he explained elsewhere, it was that a "program is a set of numbers in a certain order, and *without human interpretation it remains only that.*"[81] In other words, as another insider critic of AI explains, "although a computing device may well have real actions and consequences in the world, those are not created by the device, but by the human and social context in which it is designed, created, and deployed."[82] Therefore, the GPS did not exist because no such context for "general problem solving" exists—then or now. Indeed, despite considerable interest in the possibility of "superintelligent" AI,[83] no program was or is yet capable of solving general problems, or problems, generally, in the real world—neither as humans do, nor as Simon and Newell had claimed machines would be able to do in a "visible future."

WHO PREVAILED?

Taube was vindicated within the decade. The cognitive simulation paradigm of AI began collapsing in the late 1960s.[84] A 1966 National Academy of Sciences report on MT was the first nail in the coffin.[85] Echoing Taube, it found MT was a colossal waste of money with little to show for its efforts.[86] The following year, the GPS, unable to solve anything more than "toy problems," was "laid to rest."[87] At MIT, Joseph Weizenbaum, not yet a discontent,[88] declared the "machine understanding problem. . .is not yet solved."[89] A sympathetic psychologist concluded his 1968 survey of AI by saying that "If computer programs are going to be proposed as models of behavior, more attention should be paid to showing that the programs really do simulate. In fact, *I do not believe that this is going to happen.*"[90] In 1969, noting the lack of progress, D/ARPA, the main patron of AI since its inception, began cutting funding down to nearly nothing by 1972.[91] In 1973, the Lighthill report destroyed what remained of the field's reputation and led to the end of funding in the UK.[92]

The collapse convinced many that solving general problems was, for computers, an impossible task. Indeed, by the mid-1970s, the GPS had become an embarrassment. One researcher at MIT's AI lab used it to illustrate how promissory rhetoric had undermined the field:

> *REMEMBER GPS? BY NOW, "GPS" IS A COLORLESS TERM DENOTING A PARTICULARLY STUPID PROGRAM TO SOLVE PUZZLES. BUT IT ORIGINALLY MEANT "GENERAL PROBLEM SOLVER", WHICH CAUSED EVERYBODY A LOT OF NEEDLESS EXCITEMENT AND DISTRACTION. IT SHOULD HAVE BEEN CALLED LFGNS —"LOCAL-FEATURE-GUIDED NETWORK SEARCHER."*[93]

In other words, GPS should have been named to reflect what it actually did, rather than what its

creators hoped machines would be able to do, some day in the future.

One might opine that a more candid use of the subjunctive mood could have saved early AI from this fate. Nonetheless, here the final passage of Taube's *Computers and Common Sense* stands as an appropriate eulogy for the cognitive simulation paradigm and its flagship program, GPS: "Genuine advances are difficult and rare. And even more rarely are they the product of prophecy and the premature announcement of what someone expects to do but has not done."[94]

WHY HADN'T I HEARD OF TAUBE?

Mortimer Taube rankled the AI establishment with his original and incisive criticism, much of which proved prescient when the enterprise collapsed under the weight of its advocates' hubris. So why is he virtually unknown in the history of AI?[95]

Two events that occurred in 1965 offer an explanation. First, Taube, aged 54, suddenly died.[96] Second, months later, Hubert Dreyfus, who at his brother's invitation spent several months with Paul Armer and several AI pioneers at RAND, published "Alchemy and Artificial Intelligence," a report leveling charges similar to Taube's.[97] It was vigorously condemned by Simon and other pioneers who argued it did not deserve the authority conferred by the RAND brand.[98] Consequently, the recently deceased Taube was quickly forgotten as the field reoriented around a new enemy: Dreyfus, who spent the next decades engaged in an often bitter dispute over the viability of the AI enterprise.[99] Subsequent historical accounts compounded the erasure by focusing on "outsider" critics like Dreyfus and Searle while ignoring the awkward fact that Taube's work in information processing predated the AI pioneers'.

CONCLUSION: REHABILITATING TAUBE IN AND FOR AI

In addition to making fundamental contributions to library and information sciences, Mortimer Taube was the first major critic of AI, one whose vivid discontent confounded his adversaries. Accentuated by a sharp wit and extolling the virtue of brevity, his incisive *Computers and Common Sense* was, as the president of the Thomas A. Edison Research Laboratory observed, a "strongly labored, often acrimonious protest against unsupported claims and lack of responsibility of workers in this field."[100] Discussed widely in its time, the book condemned the pursuit of "thinking machines" as a dangerous "scientific aberration," and indicted those who claimed to build them as unwitting frauds. With it, Taube sought to introduce the "criticism of science as an enterprise similar in its aims to the established arts of literary, musical, art, and religious criticism," one that "views the scientific enterprise as an activity carried out by men [sic], not by demigods, nor even high priests."[101]

Indeed, the book was followed by a flood of AI criticism.[102] In the *Journal of Business,* for example, one author cited it to state his concern that "rather than legitimate ends, the use of the computer and the myth of the thinking machine will serve as a new instrument of obscurantism in economics. Certainly, we already have enough of those."[103]

Moreover, the import of Taube's now-forgotten critique of AI was recognized by none other than Alvin M. Weinberg, Director of Oak Ridge National Laboratory, who observed that while the "arts have always taken art critics and art criticism for granted," technoscientists assume they have no need for critics:

> *BAD SCIENCE IS SCIENCE THAT DOES NOT AGREE WITH NATURE; THERE ARE, IN PRINCIPLE, OBJECTIVE CRITERIA FOR DECIDING BETWEEN GOOD AND BAD SCIENCE. BUT TAUBE'S MAIN CONTENTION IS THAT IN A FIELD SUCH AS [AI] WHICH DEALS WITH HUMAN ARTIFACTS (COMPUTERS) AND WITH LOGICAL, NOT EMPIRICAL, ISSUES, THE TRIED-AND-TRUE CRITERION OF AGREEMENT WITH EXPERIMENT NO LONGER SERVES TO CULL THE BAD FROM THE GOOD. NOR IS THE REVIEW OF EDITORS OR FELLOW WORKERS OR GOVERNMENT ADMINISTRATORS SUFFICIENT—IN TAUBE'S OPINION ALL ARE TAINTED WITH THE SAME POISON AND, BEING TAKEN IN BY THE SAME ALLEGED SCIENTIFIC FRAUD, CAN CRITICIZE ONLY IN DETAIL, NOT IN PRINCIPLE. IF THE SCIENTIFIC ACTIVITIES TAUBE CRITICIZES WERE CHEAP, NOT MUCH HARM WOULD BE DONE; BUT SINCE COMPUTERS (LIKE SO MUCH OF MODERN BIG SCIENCE) ARE EXPENSIVE AND ARE*

SUPPORTED BY PUBLIC MONEY, TAUBE ARGUES THAT IT IS NECESSARY AND VALID TO SUBJECT THESE ACTIVITIES AS A WHOLE TO THE KIND OF CRITICISM TO WHICH ART IS SUBJECTED, TO CRITICIZE BROADLY THE ESSENTIAL VALIDITY OF THE ENTERPRISE RATHER THAN TO ARGUE ABOUT THE DETAILS WITHIN AN ACCEPTED CONCEPTUAL FRAMEWORK. THAT SUCH A COURSE IS EXCRUCIATINGLY DIFFICULT, IF FOR NO OTHER REASON THAN THAT SCIENCE IS DONE BY SPECIALISTS AND BROAD CRITICISM OF SCIENCE MUST OF NECESSITY BE DONE BY PEOPLE WHO KNOW LESS THAN THE SPECIALISTS, DOES NOT DETER TAUBE; HE SEES HIS DUTY AND HE STATES HIS OPINIONS WITHOUT PULLING PUNCHES.[104]

Weinberg concluded with the hope that Taube's critique would enjoy influence beyond AI, for "Much of modern Big Science could be helped by a dose of such unsavory, but necessary, medicine." Likewise, the present author hopes the reader will join me in pondering whether this is any less true today.

Although the technical basis of today's "machine learning"-based AI differs from the cognitive simulation paradigm of the 1950s and 1960s, much of Taube's critique remains relevant. His analysis of the AI pioneers' use of language—especially their failure to use the subjunctive mood—provides an important touchpoint for deconstructing the disingenuous "hype" so common today. He revealed how texts were deployed in an interlocking web of peer-citation to socially construct "thinking machines" long before actor-network theory showed this to be a fundamental aspect of technoscientific power.[105] Though trained as a philosopher, social and economic analyses were central to his critique, distinguishing his work from critics such as Dreyfus and Searle, who rarely strayed from philosophy. Understanding science and technology as social activities ultimately meaningless if not helpful to the public, Taube decried those who used the term "science" to "peddle nostrums to a gullible public" and avoid scrutiny "by insisting on the pure scientific nature of their intentions."[106] He believed critics "must have a sense of public responsibility and a feeling for the public good as a criterion" in their work.[107] To this end, he eschewed the armchair and built information technologies to augment the intellects of academic researchers and government policymakers, whom he saw as allies to the laity in an increasingly complex, technological civilization: A fine model for AI workers today.

Yet these are not the only reasons Taube is an important bridge between early AI and contemporary criticism of technoscience. While he did not directly address certain issues that have increasingly drawn attention in AI, such as race, gender, and identity,[108] his argument that the entire enterprise is a scientific aberration provides a solid philosophical foundation for unifying diverse social concerns within a single frame. Though the doctrine of "Man-Machine Identity" continues to undergird modern AI, it is an article of faith—not a fact. By combatting this conjectural conviction that humans are just "meat machines," AI workers, critics, and discontents of all stripes can build upon Taube's legacy and contribute to the construction of a humane future in which this pseudoscientific ideology comes to be seen as an embarrassment to technological civilization, not unlike eugenics or physiognomy.

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