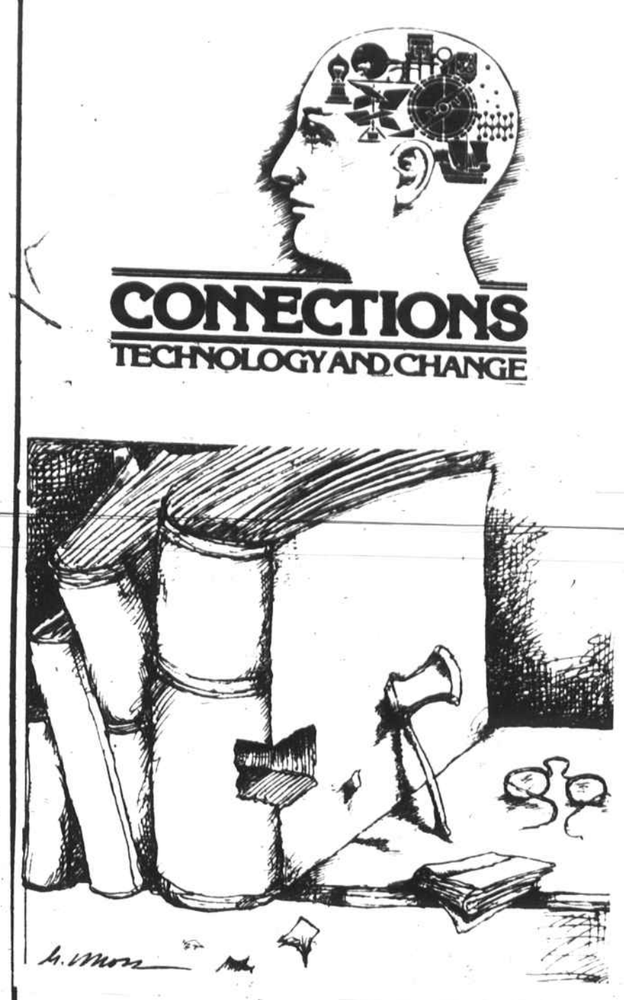


How Terribly Technical

by Derek de Solla Price

The force of science and technology controls much of the modern world. It holds the purse-strings of civilization, forms the basis of military might, and dominates the quality of life and the possibilities of the future for every person on earth.

Why then does it seem beyond the control of the people, beyond their comprehension? Why do scientists talk learned gobbledegook and behave like an elite power group, protecting their mysteries and the basis of their power? At the same time, why does the mass of humanity seem herded into a world of nuclear rebellion, megadeaths, food additives, conspicuous technological consumption, and mindless computerization?

The rapid growth of science and our increasing dependence on high technology have produced a widening gap between scientists and the general public—a gap that has been only partially bridged by education—and that only in the few most developed nations.

From the beginning science and technology were like any other field in which some people were cleverer that others. Right at the start of history in Mesopotamia five thousand years ago, a most sophisticated and complicated craft of arithmetic and a mathematical treatment of astronomy developed. It was incredibly successful and accurate—and as incomprehensible to the common persons as higher mathematics has been ever since. It set a pattern that has persisted right down to modern mathematical physics and the other sciences related to it.

Mathematics from the start involved not only a special talent but also a long, difficult investment in years of learning. We do not know the practical function—if any—that these mathematical skills had. Were the learned Mesopotamian priests and the Greeks, Arabs, and medieval and renaissance scholars that followed them deliberately hiding their skills from the common people? There was no conspiracy of an elite.

Two Revolutions

In the course of history two great changes in technology caused scientific knowledge to become more elite. Around 1500 AD came the Gutenberg Printing Revolution. The book very quickly changed the entire society. Presses were built and run by craftspeople in the cities rather than by scholars in monasteries and universities, and both the writers and the readers of the new books were a new class.

What happened with the opening up of science to its new public? Certainly there was a general democratization, but the arcane mysteries of highly technical knowledge persisted.

Then in the 17th century came the Scientific Revolution. The telescope and other instruments changed the status of our attempts to understand the universe. Before, it had depended only on brain-power, and all philosophers worked with the same evidence. Suddenly Galileo saw mountains on the moon, satellites around Jupiter, thousands of stars nobody had seen before.

It was a discovery of an artificial method of revelation (which the church could not then accept), and it changed the universe that was to be explained. From then till now, the effect of technology upon science has been the most powerful means of improving our understanding of both the natural universe and manmade technologies.

Scientific Journals

To cope with the new flood of learning, enthusiasts began to band together into societies. Making use of the presses, they began a fresh tradition of scientific journals in which they published items of new knowledge as they came in.

At first it seemed illicit to publish atoms of knowledge in this way without maturing them into a life's work book, but the method flourished particularly well with science, and a society of writers and readers of scientific research papers grew with enormous rapidity. The papers themselves became a world body of literature incorporating the new understanding of science and technologies.

Had the technologies of communication and instruments bred a new elite? Certainly they developed a new set of words and a special impersonal literary style appropriate for new thoughts. Some scientists were noblemen, physicians, clergymen, professors, but others were artisan instrument-makers, working surveyors and navigators, and mechanics or just enthusiasts, like modern stamp collectors or birdwatchers.

What happened, however, was that the enormously accelerated pace of new knowledge and ever-increasing sophistication of theory continuously removed the new scientific understanding from the majority of people simply because with each generation, despite increased education, more had to be learned, more skills had to be acquired.

By the 18th century the exponential growth of new knowledge (doubling every ten years) and new technologies had reached the point where workers like the Luddites in England broke the machines that threatened their livelihood. Even the scientists could not keep up.

Encyclopaedias and summary abstracts of research papers to wrap up the learning into digestible form offered one solution. The great French Encyclopaedia was frankly political in its attitude to the technical knowledge of all skilled trades, publishing all the alleged secrets that might oppress the populace by forcing them to toil as apprentices rather than read and become masters. In the same spirit, new democratic elements in society forced disclosure of technical secrets as a published patent, in exchange for a commercial monopoly on the new device.

Needless to say, the encyclopaedias and patents did not solve the problems of nonscientists, but merely enabled the basic problem of availability of knowledge to grow another stage.

Around 1800 there was another crucial growth in science: Galvani and Volta, looking for the secrets of life, found current electricity. Within a single generation, electricity transformed chemistry into a wealth of new substances and new understandings. The 19th century saw such new technologies as fertilizers and soil chemistry, dye chemistry and explosives, steam engines and locomotives, as well as electrical energy.

The steam engine had grown from a "low" (non-scientific) technology of water-pumps, but the chemical and electrical high technologies required the scientific knowledge of the day. In industrial nations education had to be expanded to produce the technical workers, and popularization prepared the public for the new age.

By 1900 the wealth of the major nations and the quality of life for their people were linked more to the new technologies, low and high, of manufacture than to the natural wealth of the land. Increased understanding brought forth more and more high technologies.

By 1950 the wealth and power of nations and lives of all people began to depend ever more on the high technologies and their inevitable link with sciences that were increasingly technical and learned, and beyond the understanding of the general public.

In the last quarter century, new efforts to popularize science and make it understandable to the lay person have lent increased urgency to the problem of the closed shop of science. But workers suffering from the impact of new technologies, appropriate and inappropriate, have broken the machines like the original Luddites. Today the popular rebellion is against nuclear reactors and genetic engineering, and in nations like Iran, everything technical.

We cannot all be scientists (nor want to), and we cannot ignore the existence of the world's stock of science. But we are of necessity all consumers of more or less free choice in the technological world.

The traditional answer to ignorant domination by technologies is education, but it is still only a partial solution of an irritating and desperate problem—one that we may never be able to solve completely.

About the Author

DEREK DE SOLLA PRICE has been Avalon Professor of the History of Science at Yale University since 1959. He holds doctorates in both experimental physics and in the history of science. A consultant on science policy to several governments and international bodies, he has published some two hundred scientific papers and six books, including *Science Since Babylon* and *Little Science, Big Science.*

naomi's view

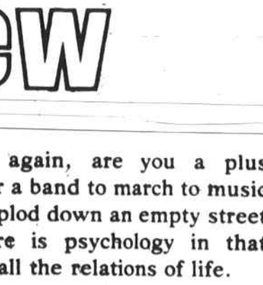
Schools have opened again, are you a plus teacher? It is far easier for a band to march to music and applause than it is to plod down an empty street amid dead silence. There is psychology in that thought which applies to all the relations of life.

All of us respond to the music of appreciation—words which reveal to us the fact that what we are and what we are trying to do is appreciated by those with whom we come in contact.

Every student in every one of your classes longs for an appreciative word from you. That word will light up the day for him and give him a new eagerness and ambition. It is quite true, we are all so constituted that we want to live up to the expectations of someone who shows us that he appreciates what we have done or are trying to do.

Life is full of drudgery—commonplace, unexciting work that has about it a good deal of the routine. That drudgery is lightened when somebody shows us that he has a sympathetic understanding of the burdens that beset us every day. Working with students in an appreciative spirit is the sure sign of the plus teacher.

On the other hand, the primary responsibility of every administrator is to provide conditions that will increase the morale of teachers, as well as to give the teachers enthusiastic and wholehearted support.



Naomi C. McLean

A true fact is, the success of every school of every kind depends in the last analysis, on the teachers. Recruiting students is important. The right kind of public relations is equally vital. But it is what happens in the classrooms that determines the quality of the school.

Why do men and women teach? Primarily because they find in teaching the opportunity to do work that brings them satisfaction.

Enthusiasm on the part of the teacher creates enthusiasm on the part of the students. Genuine love for work inevitably generates that love in students.

The **how** of teaching is more important than the **what,** and the most satisfying results from teaching are when the work is done in the attitude that is truly helpful to every students. It is now at the beginning of another school year that the daily fight against the deadly routinism is important.

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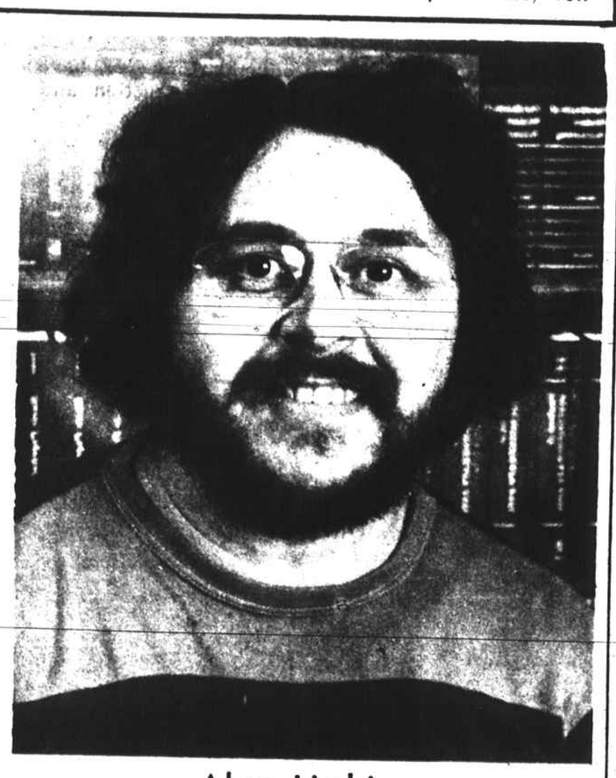

Alan Lipkin

First Forum Slated

The first of ten weekly forums on "connections; technology and Change" will be held Thursday, Sept. 20, at the Main Library on Fifth Street.

The forums will be a major part of the local package of CONNECTIONS events, which also includes feature articles now appearing each week in **The Winston-Salem Chronicle.**

Speaker for the evening will be Alan Lipkin, professor of natural sciences at Winston-Salem State Unviersity. Lipkin will demonstrate "Technology Made Simple" and lead an audience discussion on whether ordinary citizens can understand science and technology and how it really affects their daily lives and their futures. Moderator for the entire Library series will be Dr. William F. Sheppard, Director of Extended Education at WSSU.

The program will start at 7:30 pm, with a previewing showing of the first episode in the ten-part CONNECTIONS television series to be broadcast nationally on PBS this fall.

Entitled "The Trigger Effect," this series opener follows narrator James Burke as he pursues the first of his "detective stories" tracing the complex webs of technological development and interdependence. Burke explores the idea that throughout history, one simple change, often accidental, triggers any number of other changes until we live in a complex network where a breakdown in one part of the system inevitable causes breakdowns, even disasters, in other parts of the system, which

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