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The Coming Technological Society

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We are all aware now that we are in rapid transition to a new, highly technological society and we look forward eagerly to the promise of future new accomplishments and experiences for man. But we have reason to be apprehensive, if not alarmed, at the obstacles and pitfalls already discernible just ahead. Even if the coming technological society is accepted as an eventual blessing, the transition to it threatens to be chaotic.

Learning how to release the energy of the nucleus has already given man the possibility of improving the surface and the weather of the earth. We are beginning to use near-in space to broaden the efficiency of our two-dimensional surface civilization, and we are on the threshold of extending man's habitable reaches into the vast three-dimensional outer space around us. We are penetrating to a new depth of understanding of the secrets of the life process itself, with more than a hope of bettering the species and at least dramatically increasing man's ability to control disease. We are moving rapidly toward a semi-automatic society in which man's material needs can be satisfied in ample, required quantities, with little effort by man himself. If science and technology are used to the fullest in the interests of man, his future happiness and progress seem assured.

However, to attain these rewards will require solving tremendously difficult problems of readjustment of our society. This would be true even if we had a socially mature civilization today. Were our social problems under excellent control, and the top brains of mankind engaged in full-time supervision of the application of all new scientific discoveries to the improvement of man's lot on earth, it would still be a tough job. But the dislocation will be more and the adjustment harder because we do not have a sufficiently advanced society. There is instead an enormous mismatch between technological acceleration and social lag.

Thus, it is true that we have learned how to release huge quantities of energy in a split second, but so far the big impact on the world has been the threat of civilization's being wiped out before we develop means to ensure that such man-made destruction will not happen.

We have many pieces of equipment in space and we are planning more. However, today's large U.S. space effort did not come about because our society recognized a need and an opportunity and organized a plan of high priority to meet the requirement. Instead, the program became big and important on a sort of emergency basis to answer a prestige challenge handed us by another nation contesting our world position.

Biologists' researches have now deeply penetrated the nucleus of the basic cells of living matter, but at the moment that does not seem nearly as important as the population explosion problem, in view of society's inability to arrange birth control measures on an acceptable, practical, world basis.

Electronic information systems can literally make the physical operations of the world perform with such automatic efficiency as to multiply by severalfold the value of our natural resources and the brainpower of our skilled population to produce for all of man's needs. But such a possibility is overshadowed by the attendant fear of mass unemployment and dislocation of the American working force because we are not, in timely anticipation of this benefit, working out means for assuring its smooth embodiment and containment.

The imbalance between technological and social advance may well be regarded by future historians as the number one problem of the twentieth century. But it is not insoluble. There is hope. Discussion of a single area of technology – probably the most significant of this century – brings into quick focus the changes required in our thinking if we are to try making the transition to the new technolog-

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ical society a tolerably livable one. This scientific area is the extension of the human intellect by technological devices. It is the use of electronics to acquire information, remember it, and retrieve it — to compare, sort, categorize, and process facts into forms suitable for decision and control, and to communicate and display information.

All of this will be used to change the way man operates the activities of the world that depend on intellect and information. It is the automatic handling by electronic systems of all of the information basic to the professions, to the operating of business and government, the supervising of finance and transportation, and to all other of the operations of our busy society.

In the past two or three centuries we have absorbed the great impact of the use of artificial devices to extend man's muscles — his natural force-producing capability — by machine. That industrial revolution completely changed our way of life and the position of nations. We are now beginning to take a vastly bigger step, the creation of synthetic intelligence so that the total brainpower of the world can grow by orders of magnitude.

The need is great, and technology has an answer to this need. The only question is how much confusion and dislocation will result.

Consider, for example, the basic job of keeping track of everything that goes on to assure that it is in accordance with the laws, the rules of our society. In a few decades, when two individuals or two corporations want to make a legal arrangement, or if someone wants to apply for a license to do something, or if property changes hands, the information that applies to the actions will be introduced on a console-like electronic device. Immediately, the information will be transmitted to a national center, where the information and rules pertinent to such actions will be instantly available, again electronically. An answer will immediately come back saying that the action is approved and properly recorded, or more information is needed, or perhaps that the proposed action described is illegal. If the situation requires higher deliberations because of complexities not fully covered by the stored logic and data, then the system will automatically prepare the basic raw material in a form that saves much human effort.

All of this is technologically feasible today; the next few decades will make it economically feasible as well. In addition, the increasingly complex and fast-paced society in the coming years will present us with an avalanche of paper work, red tape, communication, and interaction. Our operations would virtually come to a halt through indigestion if not rescued by some kind of electronic information handling system.

Medical practice in the future will be aided by information technology to a degree comparable in its significance with the advent of surgery. A practicing physician will introduce the data on a patient, his own observations, tentative conclusions, and proposed treatment, into a national medical informational network, through an input device in his office. He will immediately receive a custom-assembled compendium of pertinent reactions to these data and diagnoses. He will obtain the equivalent, in part, of consultations with thousands of physicians on similar situations, on the relationship between cause and cure, on statistics regarding drugs and treatment, and, over-all, a great backup to his own intellect and knowledge. He will, of course, introduce his experiences regularly into the network. New professions, as specialties of medicine, will arise to create, maintain, improve, and operate such a network to extend the brainpower of the highly trained human medical practitioner.

The managers of business will have available facts on their operation, so well displayed, tied together, and processed that management can be confident the operation is close to the optimum plan they desired. Electronic control of this information will enable the skilled, more creative human managerial intellect in business to be applied to the difficult policy and planning problems and to the arrangements among businesses. The machine will

take on the job of storing, pondering, and providing all needed information, on call, and in numerous quickly changed forms.

The stupendously fast processing of mundane data in huge batches, the delivering of that information anywhere in the world at the push of a button — these are facets of intellectual-information activities for which the human brain is not suited. This capability, when matched with man's remarkable capability to associate and contemplate complex interrelationships, will make for a new superior level of business and industry operation.

Electronic education

In education, information stored in electronic systems can be presented efficiently to students, who can be asked to provide their push-button response. In accordance with stored rules, the presentation can be automatically speeded up, slowed down, repeated, or shifted to other material, depending upon the apparent ability of the student to understand, as indicated by his answers. This "closed-loop," sympathetic feedback between the nature and speed of presentation of material and the student's response represents a whole new dimension in teaching aids. Students of our century may one day label it as of equal significance to the invention of the book.

Educators will find other tools in electronic information systems. They will be able to obtain detailed records on individual students automatically, on a moment's notice. They will be able to synthesize a custom presentation and test for a single student, even as they process statistics on millions. The educational profession, aided by a synthetic intelligence system that takes the burden of the mass handling of the more mundane intellectual tasks, will be able to rise to a new, higher level of intellectual attainment.

Financial and acounting operations will be revolutionized by electronic information networks. Personal checks, and even currency and coin, will be delegated to a few rural areas or museums. When you buy a necktie or a house, your thumbprint in front of the little machine will identify you, subtract from your account, and put it onto the seller's account; all through electrical signals. The data will be assembled according to rules, the government will take its cut in taxes, and all accounts will be kept straight by the pervasive electronics information system of the future.

What we have been describing, had we continued in detail, would disclose itself to be a major redoing and up-dating of most of the physical resources of the businesses and industry of the world. We are talking about not mere millions, but rather trillions of dollars of investment in new technological equipment, systems, and procedures affecting and improving the way factories, steel mills, railroads, banks, schools, and the professions are run. Tens of millions of people will have their individual jobs altered in detail. So the impact of technological change, particularly when man's brainpower is extended by machine, is bound to become a major, if not dominant, political issue of the century. The retraining and relocation of people, and all other arrangements to make certain that rapid technological change does not destroy the economy, will be subjects of heightening discussion. Under such circumstances it is unavoidable that the government will be involved. We will go on arguing about how *much* it should be involved, but involved it certainly will be, and in a very ubiquitous way.

As in the telephone and power utilities, which are government-granted monopolies, so the careful assignment of roles and missions among different contributing segments of our nation in information-automation will also require government chairmanship and refereeing. The government must allocate radio frequencies for communications. The language and format for electronic information systems must be universal. The input and output devices for man to use, the interconnections, central station devices, the locations for processing of the information, and the control of all the stored information for business, medical, legal, and other uses will require organization, planning, standardization, and compromises.

Government, the biggest customer

The decisions will involve many semi-autonomous groups, some operating industry, some designing and manufacturing the equipment, and others operating the networks. The government is itself already the biggest customer. It has more information to handle, and is involved in more detailed day-to-day decisions than any other single entity. As a leading customer, it will in any case have a very large voice in deciding how to design and arrange the system that it will be using.

Finally, the investment required for the changeover is so great, even when spread over decades, that the government will probably end up being the main financial backer.

With electronic systems helping to control the operations of private business and industry through information that is complete, automatic, up-to-date, and utilized fully, management can rise to a new

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higher level of competence. Managers will spend a greater fraction of their time in planning and in arrangements with the outside world that affects their operation, confident that the internal operation is under close control. As more and more of American business and industry begins to be dependent upon, and becomes a part of, the information network, its day-to-day operations will be more tightly controlled in accordance with a plan. An increasing number of separate organizations will be tied together electronically to assure optimum operation between them, so that what one does constitutes a planned and agreed response in view of the activities in the other. As top management works out these relationships, taking care of unforeseen emergencies as part of the understandings and rules that are set up, a larger and larger fraction of the total American economy becomes, for all practical purposes, a planned operation.

The web will become increasingly intricate, complete, and solid, reaching every small operation and assuring that all materials and information are in the right place at the right time. A highly efficient operation is thus approached, with top management moving increasingly toward higher level problems. Private management's preoccupation with goals, bigger interconnecting arrangements, and international relationships will link it more closely to the top of government — which begins to become indistinguishable from the top of industry.

Now, what kind of organization of society does this projected trend of technological advance bring with it? Are we ultimately forced, knowingly or unknowingly, to accept that dreaded "planned economy," the very antithesis of free enterprise?

A planned economy concept, as we know, usually engenders negative connotations. It is associated with the thought of a small group in government presuming to plan for the individual, usurping the rights and destroying the American habits of the citizen to freedom of choice, and interfering with the natural forces that might otherwise give us a more energetic, thriving economy.

On the other hand, a natural, unfettered, free enterprise, which automatically gives us the benefits of individual initiative, competition, incentives, personal creativity, and freedom from government control and interference, seems hard to associate realistically with the highly controlled operations which appear to be inherent in the future society's inevitable way of life. Aside from having the government as a certain, pervasive partner, the optimized automatic arrangements for operation of all activities implies circumscribed, rigid, formal controls. The individual participants will find it difficult to go off freely in newly conceived, personally initiated directions.

Do we find ourselves, then, forced to choose between *something* we don't want and something which can no longer take place? Is there a third possibility?

I think there is. And I think that it is more likely than the other two. I hope I do not disclose myself as too much of an optimist in describing this third approach not only as probable, but as a have-your-cake-and-eat-it-too possibility.

Nothing approaching a true planned economy is conceivable in the future unless we postulate in that future an efficient, universal network of information-acquisition and dissemination. No dictator or central group in government would get anywhere, even if we willingly handed them the task of planning and controlling all our activities, unless they had this national mass fact compiler. They would also need its counterpart, the means for disseminating signals to control everything down to the depths of the details of the economy of the nation. Otherwise, direct as they might, there would be random, uncontrolled responses to their directives, and a tremendous amount of independent action. In fact, most of the details that in the end would really control the economy would represent actions completely outside the scope of their limited coverage. Unless they were able to gather enough of the facts on an on-line, real-time basis, process these facts in accordance with detailed, stored plans, and get the control directions out in like detail, they would not be able to assure adherence to their control at all.

Now a large, fully developed, national electronic information network, necessary for a true planned economy, is not just a means for acquiring the facts, or even for disseminating and displaying directions. It has to be a system for processing facts and stored logic into alternative courses of action, which are compared and communicated. A system that makes real planning and control possible, also makes managerial knowledgeability possible; more important, it also makes citizen knowledgeability possible.

A network that possesses the information to control a nation's physical operations, that is designed to disclose the trade-offs of benefits among possible decisions, also can readily make these alternatives known to the people at large. Moreover, a well planned economy that derives from a good information network is one that is planned to match with needs. It is a matter of good design that the plan should be compatible with the desires of the consumers, the users of the results, the mass public, for whom the economy is being operated, and for whom it will operate with much greater success if those consumers understand and have participated in choosing the alternatives.

Some speculative inventing

Citizen participation is technologically feasible in the world of the future to a much greater extent than today. Will it happen? Is it practical? Let us do some speculative inventing to show quickly that it can be done.

Imagine for the moment that the society of the future could include, as part of our everyday pattern of living, that we "vote" during a few very significant minutes each day on our choices amongst alternatives. We might all be connected to the national information system through an electronic box at home, which might even be integral with our TV sets. Instead of the commercials, or (more realistically) in addition to them, every 10 or 15 minutes we will have displayed to us candidate products for the future – proposed new automobiles, places to go for vacation, kitchen equipment designs.

We might be shown four or five different automobile designs for a year hence, with the stated prices dependent upon the quantity chosen, the extent of unanimity of decision, whether two-door or four-door, and whether large or small. We might even be asked to "put our money where our votes are" by agreeing to purchase a car a year ahead, such a decision giving us a reduction in price. Our push-button responses on the spot would go into the national information system and the results would become an important ingredient, in many ways a starting or determining parameter, of the "planned economy." Our financial commitments would become binding, and our votes would become a part of the decision-making, the financing, the scheduling of production and employment, and the phasing of deliveries.

Thus we see two ways, in principle, that our society can benefit from the technological revolution in the handling of informational and intellectual activities. One is in the improved management and control of all of the material requirements of our society, with a man-machine, on-line partnership providing us with our goods and services, keeping everyone supplied, everything straight and everything moving.

The other is to make possible a new level of interaction between the economy and the citizens. Within the new, broadened realm of technological feasibility, an increasing number of citizens could learn enough and be heard from easily enough so that it would be natural and likely for them to express their interests, their curiosity, creativity, and desires. Proposed alternatives could be dealt with quickly, and the results communicated to all. The decades ahead could become ones in which the citizens are more informed, more interested, and are more spirited, active participants. We could have "on-line" democracy. This could happen, remarkably enough, despite the fact that the response to the citizens' whims and interests could be regarded in another sense as a controlled, carefully meshed, precision-operated society.

Social advance and technological acceleration

Social advance has not been keeping pace with technological acceleration. But maybe that trend will be curbed. Technological change has been giving us too great a mouthful to swallow. On the other hand, science seems to be able to give us more and sharper teeth to help get that mouthful down. With synthetic electronic intelligence taking the big load of mundane data handling off of the human intellect and extending our brainpower, we may have the opportunity to rise to a new level of human attainment. Maybe that new total of intellect, natural plus synthetic, will be sufficient to enable us to speed up social advance to reach the balance required. Historians some thousands of years from now may call the last decades of the twentieth century the most significant in the history of the human race. It may become the period when man learned how to increase his intellectual capacity and, from then on, to utilize science and technology to the fullest for society's advance.