

CULTURAL AND SOCIAL CHANGES.

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WE ARE LIVING at the end of the Neolithic Age. The changes taking place in the world today are not merely changes from one form of society, one form of technology, to another. They are so wide-sweeping that they are taking us from one major epoch of human history into another.

To find a parallel set of phenomena, we must go back many thousands of years ago, to the beginning of the Neolithic Age. At that time, another set of changes occurred, and the race of man entered a completely different way of life from that which he had led a few hundred, a few thousand years, before.

Therefore, I am going to discuss what it means to live at the end of the Neolithic Age. The changes in which we are involved are deep, pervasive, irresistible. We may stay them for a while or in some part of the world, but we cannot stay them everywhere, nor for long. Their direction is irreversible; they are happening all together, and they are happening one as a function of the other. Our past has prepared us only partially for them, and for some of them, not at all.

Among the changes are these:

J. *In work and property.* Most of what we have known as work in the past is disappearing rapidly. And our concept of property is changing, for the things one owns and the meaning of what it is to own are at last approaching the end of a long series of changes. At the beginning of the Neolithic Age, when man settled down on land, he invented agriculture. First there was sacred, and only later, apparently profane agriculture. With the invention of agriculture came the invention of property, and then the ethical description of what it was to own something; but here the act of owning is defined in terms of a thing-type object. And so, for ownership you must have some *thing*. The act of ownership establishes some kind of relationship between a person and an object, excluding others from this relationship. However, this kind of ownership did not appear until man settled, became static, became Neolithic. Then, at that

stage of history, man invented this exclusivity, and the residence of ownership in something material. Gerard Piel, in his book *Science in the Cause of Man* describes these two phenomena eloquently.

2. *In the family.* Even until recently the family was a kind of plant with dependents, relatives, servants, slaves, living in a house or house-type factory, for a long period of time, in the expectation of the owner's creating an estate and passing this on to his descendants. But the family at last has been pared down to the bare core of a husband and wife, some children, no servants or relatives. Members of a family live for increasingly short periods of time, not in a house, but in a space valve. They move from one such space valve to another in our society, not attached to land, to city, to house.

3. *In business.* The meaning of business has changed. Instead of depending upon agriculture for the creation of wealth, supplemented by mercantile activity, and then independent, sporadic invention occurring as a result of genius, we have invented the organization of invention. And at the very same moment, we have brought into existence - and in the decade, I should say, of the 1950's recognizably for the first time - this institution which, for want of a better word, we call a business; and have given it the role of being the prime wealth-generating, wealth-creating organ in our society. At the very moment when we have done this, the definitions of what a business does, what wealth is, what the value of economic exchanges consists of, and the things by which it is measured, instantly change.

4. We have moved out of a mechanical or electro-mechanical age into an electronic age, whose characteristics are instantaneity, totality and random access; and this moment has occurred at the very same moment when we have achieved a plenum of science and technology, and an interpenetration of cultures. At this moment, however, what we have known as sciences and technologies disappear, in the same way that property and boundary lines disappear.

5. The same forces are moving us inexorably from tribe to polity.

6. With these changes there now emerge organizational forms not bureaucratic in nature, not whose principal dynamic lines of force are lines of authority and power, but rather forms which are based more on the requirements of an action-communication network, different from the bureaucratic forms with which we have been familiar. And at the same time the concepts and institutions of authority with which we are long familiar, and which our ancestors labored many centuries to bring into existence as reinforcements for our social structure, now find themselves

naive and inadequate for carrying on our conduct in the world which we are just now entering.

At the beginning of the Neolithic Age, man, who had been nomadic, living in some kind of loose family tribal association, settled down. After having been mobile, man became static. When he became static, one of the first things he did was to invent the wheel. Contrary to what many people think, the wheel, at least as we know it, is not an old human invention. Clubs, primitive arrowheads, perhaps the lever and fire, were old inventions. The wheel was not.

We are living at the end of the age of the wheel. It is interesting to reflect that the wheel was invented just as man became static; in centers of greatest density and of maximum stasis today, we find the greatest concentration of wheels.

Wheels have been important to the Neolithic man. But even he did not turn them into engines or parts of engines until relatively late. To take one, very old, example, I own a lovely Neolithic pot, which is about 2,500 to 3,000 years old and which comes from Hunan in northern China. It probably was turned on a potter's wheel. Then, too, I have some exquisite Neolithic jades, dating from about 4,000 to 6,000 B.C. Each jade is a disc with a hole in the center. They are not wheels used as part of an engine; they are religious objects, once used in the cult of sun-worship. After these came the appearance of the wheel as we now know it.

For an example of the changes in machines, take the **IBM** machines. All the things the old **IBM** machines did depended upon the revolution of the wheel. The passing of the cards, the harvesting of the information, the inputs into counters: all these depend upon the position of the wheel at some moment during its rotation.

The earliest computers were a transition, equivalent to an animal between monkey and man. A computer like the vest-pocket ones, like the "650," has a rapidly rotating drum for the sake of the program; it is a transitional form. The new generation of computers does not depend upon the revolution of the wheel.

The same with telephones. The telephone dial system found in most parts of this country is electro-mechanical; it depends upon a wheel, and upon moving parts. There is a new telephone exchange on a trial basis in Morris, Illinois. This exchange, electronic in character, has no wheels, no moving parts. It has a memory, and it does things in a completely different way.

For another example of how we have been Neolithic until now, and that we are no longer Neolithic (although we have some survivals), take

weaponry. In weaponry, we have had several changes in technology, in speed of weapons, in changes in armor to match the speed. But basically, we have been concerned with missiles, which are projected and which have been selective in their action.

At the beginning of the Neolithic Age, there were fairly well-polished arrowheads. At the next stage of technology, a long pole was put behind the arrowhead for a propellant. Next, a shorter pole. Then, the pole was shortened still further, and put in a crossbow. The flint was changed to metal, and put in a tube, with some gunpowder behind it. Then the rate of firing was speeded up.

The weapon which is characteristic of our age is random, total, non-selective, instantaneous. You cannot play the war game with a non-Neolithic type weapon. With a Neolithic-type weapon you can go on; you can prolong the game for some period of time and have some fun with it. With a random-access, total, instantaneous weapon, it is all over with the first shot.

Moreover, with a post-Neolithic type weapon, like any of the nuclear bombs, you have everything in one bomb - and you just cannot spend that much money, you cannot waste that much, you cannot squander that much of the gross national product in the new kind of warfare.

The only alternative to this is to spend forty billion dollars and send a man to the moon. This, as a friend of mine said to me recently, for a country as wealthy as ours, with as many things as we have to do, is something like the gift for the man who has everything.

Before discussing the possible impact of these changes, I shall go through what I call "my ten-minute history of economics."

The first significant moment in the history of economics occurred in the 4th century B.C., when Aristotle discovered and identified this body of human competence and gave it its name.

In his *Politics*, Aristotle describes a body of knowledge which is concerned with how the individual should order his life well; then he describes what it is for many men to live together in a well-ordered community, and this body of knowledge he called politics. And then he says: in between, there is a competence which is concerned with a society that is more than one but is not the kind that a polis or a state is. This body of competence is what we call economics. The object of this body of knowledge is wealth.

Aristotle names economics after the *oikia*, the household, because this was the prime and only competent, complete wealth-generating organ in the ancient world. In the ancient world, the household was a machine for making wealth. It also was an economic unit. It had property, oxen

herds, slaves. The major source of wealth came from agriculture, and there was some fabrication: harness-making, sword-making, shield-making, weaving.

From the ancient world until the present, we have had other kinds of economic activity. There have been the activities of traders. In this category I would include the activities of the Barbarians, such as the Franks and the Merovingians. In the spring of every year, the Barbarian tribes held their form of a general sales meeting, in which they decided what tribes they would plunder, how many furs and women they would get. They set their sales quotas, and they went off and spent the summer making budgets.

There have also been banking activities. And there have been the kinds of economic activity on which most of our modern corporation law is based, one of the reasons why the law is obsolete. This is an example of the kind of activity to which I am referring: A group of people who had some money would engage a ship's master. He would impound a crew, get a vessel, go to Africa, get slaves, and take them back to America, where they would be sold for money. Then the people who were paying for this venture would take their new wealth back into England and disband. This was an early extractive industry. What they had over and above their expenses, they called profit. And this is what becomes P&L on a statement. Someone owns it and distributes it to his stockholders as if they owned it.

We had many things like this. The theory of the early economists follows the same pattern as the theory in physics that there is just a certain amount of matter in the world, and there is just a certain amount of motion or of energy. All that you can describe in classic physics are the transfers that take place. You can change the piles in which matter is gathered; you can describe the mechanisms by which it is moved from one place to another - but that is all!

Likewise, in classic economics, there is a thing called wealth. This wealth is related to *thing-type* objects. By transforming them or by doing something to them, such as weaving, hitting, painting, carving, changing their chemical molecular structure, one can make them more valuable. And one can re-allocate the packages in which the wealth is distributed.

By and large, the Socialists, as I read them, and the early economists do not differ on this point at all. They start with the same basic assumptions; they differ simply in saying who should have the wealth, or in the mechanisms of redistribution. So they differ only in the matter of the technology of the process: How are you going to shove wealth around?

We have also lived up to now in an economy of scarcity, not the almost

absolute scarcity of poor, non-productive societies, but the tolerable, relative scarcities which made competition meaningful, which put a premium upon productivity, and which enabled us to talk about unemployment (the non-working, non-wage paying status of men engaged in largely servile labor) in meaningful economic measures.

I believe that business today, in this country, and the economy in which it is located are different from what I have just been describing. In our earlier industrial society, business was like this: The founder hires some hands in a factory to make a product, and then he hires some salesmen to sell the product for more than it cost. Then the owner takes his profit, distributes it, and retires. The next generation, the founder's descendants or the stockholders, now own the business, but they keep on splitting up the profit.

New England is full of towns of empty factories whose owners thought that a business should fit that description. Our idea of a business is very different from its antecedents. There is a source of increase of wealth beyond agriculture, beyond the shoving around of mercantile activity. This source is *invention*.

Invention originally was supposed to be the work of sporadically occurring genius. Our patent laws still go this way. Contrary to this, we have invented the organization of invention. We deliberately build organs, such as the Research and Development Department, into our businesses. The whole purpose of these departments is to create imbalance where there was a balanced money system, and to inject risk; because, apparently, you do not start creating wealth until somehow or other you inject **risk**.

The problem of designing a business with risk is something like the problem of designing a reactor. You must get the thing going, and then, once the reaction is going, you try to keep it under some set of controlled conditions so that the thing does not go wild and explode. But it has to go critical; it must get the reaction going.

In the same way, you deliberately have to inject risk into an economic institution before you begin to get some kind of wealth produced. You have to tap into inventive sources of intelligence and organize this way. Once you begin to do this, then all at once, the business becomes not a closed system, but a system in which output is greater than input.

Simultaneously with the emergence of this kind of business, a couple of very interesting things happened. One, wealth became a function of the total system, not something which is added simply by production. Not only that, but what we call money, in an economic transaction, is a

value which is created in the transaction itself and has no other existence except in that moment.

Except in that moment, or in anticipation of it, it is only inventory. Its value is what you write it off at then. So the value itself, and the wealth, is both created by and exists only in the moment of the exchange. It exists at an intersection in a very complex network. And this very fact, at the moment when a business came into existence as a wealth-generating organ, divorced wealth from property and *thing-type* objects.

We can see how far this divorce has gone. Until recently, most of what people made, traded, sold, bought, were *things*. Mixed in with the material component, there is a competence component in the thing exchanged. For example, shoes are made of leather, string, glue, and also of competence to walk well with feet protected from stuff on the ground. Now, in the great majority of our economic exchanges today, the competence percentage of what we buy and sell is rising very rapidly in relation to the *thing-type* component.

An example is what IBM sells. What kind of business is IBM in? At an executive conference, sometimes the participants go through a little intellectual exercise of saying: What kind of business are we in? If you say **IBM** is in the business of making and selling office machines, that is one kind of answer. A completely different answer is this: **IBM** really is selling to people the competence to manage information, the competence to handle a language, and this competence is now achieved in an electronic as against an electro-mechanical technology. The same is true for machine tool manufacturers, and other businesses of this kind. Therefore, we are moving into a world where we are paying more for the *non-thing* component than we are for the *thing* component in the product. (The OK-type, 1962 word for such competence is software, as against hardware.)

Something else is happening in business. The character of work and of the work force is changing radically from what it has been. Up to now, our organizational forms have been those which go along with a print culture.

Like our Neolithic work, printing is linear and fragmented. Reflect on the invention of the phonetic alphabet. About midway through the Neolithic Age, someone in the West invented the phonetic alphabet and writing on paper. This invention and the related technology were completed by the invention of printing from movable type.

The first step was to take the whole universe of discourse, which is multi-sensual, multi-dimensional, reduce it to one dimension, and to one sense, the sense of vision. Then the universe was broken into 26

parts, the 26 letters. The parts are non-significant and interchangeable. Every A is interchangeable with every other A, every B with every other B, and so forth.

Then these bits and pieces are arranged on a line, like T-H-E, B-I-G, F-A-T, D-O-G. This is linear and fragmented. With movable type, the completion of this technology, out of a matrix there can be cast a thousand A's, five thousand C's, and so forth. Then these letters are arranged into a book.

The book was the first massed-produced object in our civilization. The inventor of mass production was not Henry Ford; he was somebody no later than Gutenberg.

On this cultural model, the early industrial engineers made assumptions about work. They figured that work done by human beings was better, cheaper, more efficient if they broke down the process and rearranged the pieces. They took a total chunk of work, a total process or sequence of operations, and broke it into bits which are relatively fine, more on the fine than on the coarse side. Then the engineers arranged these pieces into a linear program, shoving work in here, having work come out there.

Classically, to each bit and piece of work you attached a bit and piece of pay, like piece rates.

As by over-milling flour you take out the minerals and vitamins, so by this system, the engineers have destroyed the natural dynamics and the relationship of worker to work. To keep people working this way, they put some dynamics artificially back into the system.

To keep people in such fragmented jobs and to make the whole system function, we engaged in the system of doing everything twice. We make everything once on paper, all the way through, then once in steel, or wood, or nitrogen, or whatever. The cost of getting, engineering, and processing the order differs from the cost of making the thing as the price of paper differs from the price of the material you are making the stuff in.

We go through the whole productive dance twice - unless we have an over-zealous accounting department, in which case we go through it three times!

Then we create organizationally a supervisor. This person can engage in only a limited relationship with a given number of subordinates. Then if we add the assumption that everybody must have one and only one boss, there is generated, inexorably, a managerial work structure that is many-layered and pyramidal. It gets bigger, bigger and bigger. There is an increase, exponentially in relationship to size, in delays in the transmission of action and messages, in the fragmentation of competences, in

the dispersion of competence within it. It is strictly a matter of structure.

Now, there is no reason why we should use this kind of structure. It was possible to run businesses and governments with this structure when the skills required were few, primitive, low-grade. It happens, however, that at the moment when business develops this way, when wealth is a function of the network of the exchanges which go on within it, and not just of the things it makes, we all at once entered a world where at last we achieved command over nature. We have begun to live in a world in which there is a plenum of science and technology.

By command over nature, I do not mean simply that we are able to invent things like a flying machine or a steam engine, but for the first time, we not only know how to invent something, but also we have organized this process. The process of invention works backwards; that is, you first decide what you are going to invent, and then you select the competences and the technologies that you need for this. If you do not have the technology, you then know how to invent the technology itself - and we are doing this now all the time.

Recently, I was in Huntsville, Alabama, with Werner von Braun and his group of people, who make rockets. While I was talking, very casually, with the man in charge of advanced planning, he said that we know already what we can do in the next fifteen years; it is just a matter of selecting what project we are going to do and deciding that we are going to do it.

For example, one of the things we are thinking of doing is making a space platform. Probably the first effort will be somewhere between Mars and Venus. The platform will pick particles out of the cosmos, gather them and turn them into fuel. Fuel will be made there with just a little, independent, completely automated, cosmic fuel plant for rockets. We will just land out in space and refuel, so that we do not have to take off with so much load on the way out of the galaxy.

That which Simon Magus tried to buy from Saint Peter, that which Albertus Magnus was playing around with in his laboratory at Cologne, that which Roger Bacon and his associates were trying to do, that which Francis Bacon wrote about in *The Advancement of Learning*, we now have!

At the moment when we have it, though, everything that we know as a science has changed. Physics is not what physics was. Biology is not what biology was. Chemistry is not what chemistry was. A few years ago, it used to be fashionable to call the sciences interdisciplinary. But we know that the phenomenon is more radical than that. In the same way that property has disappeared, and boundary lines along with it,

there has been a disappearance of knowledge as something in which you can have property, in which there are areas, in which there are fields, in which there are proprietary interests, like the interests of a professor of this as against that.

With this disappearance, we know that all our university curricula are obsolete, just as those in our technical schools, because, instead of teaching electrical, say, or mechanical engineering, we need to teach people how to design a system. And our professors, not our students, do not know how to do this. We are having to get ourselves through the barrier.

The network of economic exchanges is also different. It no longer goes like the flow of energy in an old-time electrical circuit; it is not like hydraulics or plumbing, where you have water in the reservoir up here, so you have pressure up here and no pressure down here, and water flows down.

It is still possible to engage, as older empires did, with less favored nations, where you treat them as suppliers of raw material and then send back to their people the products you made. But actually, the most profitable kinds of economic exchanges are those which take place between equals and people who are equally wealthy.

California is an example. Twenty years ago, it was very difficult to do business with California. There was not enough money, nor enough people; there was not enough industry, nor enough economic competence. At the moment when California began, in wealth and in economic savvy, to approximate at least the Eastern Seaboard, then it became possible for us to deal with them in a variety and in a volume and richness of economic exchange which was impossible before.

Today's world, too, is electronic, total, instantaneous, non-mechanical. We are living in a world in which there is an interpenetration of cultures, and in which, for all practical purposes, there is no distance.

It is a world in which it is impossible to keep a secret. The only secret you can keep is the fact that there is a secret. Once this is out, anybody with enough resources and enough industry can invent the very thing which is your secret.

This is the kind of world, therefore, in which you move from having security attached to a *thing* to security attached to the network, in which you move from security being attached to stasis to security being attached to increased mobility, because it is only at the maximum of mobility, or at the maximum of stasis, that you have security. In between, you have wobble, as in a gyroscope.

Our concept of machines, too, must change. We have been brought up to think of machines like a stamping press or a punch press or a lathe.

These make it possible for human work to be more specialized, more fragmented, and less complex. Such organization, made possible by such machines, we suppose more perfect.

But this is completely counter to our total experience with nature, in which the more perfect organizational forms are more complex and less specialized. For example, man and dinosaur. Dinosaurs were pretty specialized; a dinosaur had a long neck and could not get signals down from his birdbrain to his legs in time when animals were nibbling at him. The dinosaur is not around any more. Man is more complex, less specialized; man survives.

Considering the nervous system behind a man, he is among the most complex things in nature. And it is very difficult to discover specialization in the human organism. Take the fingers, for example. What can you do with them? You can play the piano, brush your teeth, paint, shave, do appendectomies. The system of our fingers and thumbs is general purpose, non-specialized, highly complex.

We supposed that more perfect machines would be simpler, bigger, more specialized. We made presses that had dies in them, settings; they got bigger, bigger, bigger.

Now, the new generation of machines is not like this at all. One example of the new machines is the machine for making automobile tailpipes. Made by Milwaukee Machine Tool Company, it is programmed with General Electric thermoplastic tape. You start with just lengths of pipe. There are no dies, no machine set-up time, no special-purpose things. But the machine has things like hands: grippers, advancers, benders; and in the back, there is a little console through which a piece of thermoplastic tape runs. That is what determines the shapes that machine makes out of a pipe.

On this machine, you can make eighty different tailpipes in succession as rapidly and as cheaply as you can make eighty of the same one. This is something different.

When you have a network of these machines, which can be programmed and related to each other in a factory, you have the complete capacity of the machine to replace servile work. And it's about time!

To emphasize the magnitude of this change, I want to point out that these machines will replace not simply people who are screwing things, hitting them, chopping them up. The machines also will replace some people who have been engaged in the processing of information. Do not think that only the file clerks have been doing this. There are engineers at drafting boards who should not have been there, making routine applications. There are capable people who are wasting their time in

middle management, using 80 per cent of their time simply handling information. They are using the bucket-brigade technology for doing this. All accounting reports are like this, with a sampling of information passed from layer to layer. This is a horribly inefficient way of doing things.

With the introduction of computers, the technologically unemployed will not be simply file clerks, people who are auditing claims, and people in similar jobs, but also middle management.

Now we have a technology with which we can deal with total information. As a pilot has immediate access to any information in the control tower, we have immediate and random access to any of the total information necessary for the system to function.

The number of people we will need is going to decrease constantly.

Now, at the moment when wealth had been attached to property and property disappears, and when wealth becomes a function of the intersection of the network and at the moment of exchange, the way that we have of distributing wealth - namely, pay for work - is going to disappear, because this kind of work is going to disappear.

Then we will have a real problem in inventing not only the mechanism for distributing the wealth which we undoubtedly can generate, but also the language and institutions necessary for our new world.

You do not own a single bit of property, but you have a right to health; you do not own a single piece of thing (unless you want to name the clothes on your back, or your toothbrush because no one else uses it), but you have a right to be a part of the network where wealth is generated. You own less, less, less, and have a right to more, more, and more.

We do not have any concept of how to adjust. Fringe benefits, unemployment insurance, shorter hours are just stop-gap measures. Retraining of workers - a farce! Of course, there will be training and education, but they will be of a different kind. We will not have to spend as much time at education because the knowledge will not be organized according to the subject matter, and we will not proceed linearly from one course to another. Then we can learn much more rapidly.

Now, all of these changes are changes in which we are involved right now. This is an order of change which is completely different from anything which our ancestors knew, unless we go back about 10,000 years, when they invented property, when they invented ownership, when they invented work, and mechanics based on the wheel, and bureaucracy.