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MICROELECTRONICS — A TRIPLE TURN IN THE HISTORY OF MANKIND

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Summary

From the technical aspect microelectronics seems to be only a step in the development of electronics. However, it gives the opportunity to organize a society which is more highly informed than ever before and regarding this effect, it can be compared with the introduction of printing. But microelectronics is more than this alone. It penetrates into all spheres of human activity and radically changes the way of life nowadays. The effect of the industrial revolution was similar but the present change has more profound effects and takes place more quickly. Among the results of microelectronics the appearance of microprocessors and minicomputers is especially important. They make the replacement of human manpower possible in some fields of intellectual activity, moreover — with flexible robots — in production and in services as well. (According to an American source the price of a robot is refunded within a year in saved wages.) In the short run it can lead to considerable unemployment in certain strata hitting mainly the developing countries. Its long-term effect presumably will be a radical decrease in working hours. Thus work will lose the dominant role in human life, that it has fulfilled since olden times — in fact since the neolithic revolution.

Information, technology and history

Not so many years ago, he who risked to speak of the social importance of Microelectronics, was held either a lunatic or a heretic. To-day, however, the problem is well established in Hungarian public opinion. In getting the idea

accepted the noteworthy lecture (1) of academician Vámos had a great part, and also the great publicity given by our newspapers to the 1982 report (2) of the Club of Rome.

The present lecture were of no purpose, would it only repeat that microelectronics has a great influence on the development of society. Its aim is to inspect this influence with an engineer's eye, who is interested in the history of technology but does not claim for himself the rank of an expert in social sciences.

His available instrument is hence the historical analogy. Founded on it the statement in the title was born.

Analogy, as a scientific tool, has to be handled very carefully. With some piece of trickery a historical parallel may be found to everything — "nothing is new under the sun" — on the other hand nothing repeats itself exactly, circumstances never being the same. We try therefore to use only analogies that are reinforced by many-sided investigations.

One has also to be careful, in treating concepts like historical turning points, civilisatoric revolutions etc. If we define a revolutionary change as a change within the lifespan of an individual — what remains of the Neolithic Revolution? What about the production revolution of the Middle Ages, recognized as an important motive by some authors, as non-existent by others? We may agree, however, in accepting that human development is not a process characterized by a constant differential quotient and epochs, when the pace of change in production means, way of life and social institutions gets a remarkable acceleration, may be called historical turns.

One could object to our method that it is impossible to connect a huge historical process of universal importance to the appearance of a single technological product. However, we do not deny the complexity of the great revolutions of technology and civilisation, but state, that one can often select out of the set of innovations the one motive, which had a catalytic, if not exclusive, influence in triggering the whole process.

We think that human communication has such an outstanding role, as it belongs to the essence of any society. The great steps in the development of communication technology were either themselves alone the catalyzers or had at least an important role in the great turns of human history.

To begin with, *speech* had a decisive influence on the Evolution of Man and of tribal societies.

After hundreds of millennia, prehistory arrived to an exciting page, when Man started — in a relatively short time — to acquire agriculture and crafts. He established better conditions of life in the framework of early riverside civilizations. At the same time organized states made their appearance. Where

the first riverside empires were formed, *writing* evolved out of primitive symbols. It was the stone-carved letter of law that held the different tribes and peoples of the empire together. (Even in the Modern Age: Napoleon contributed his Code the same importance as Hamurabi to his one.) The stone-carved law was the first species of Mass Media (3).

The alfabet has changed its role, after the collapse of the antique civilization. It retained its importance within the Church, the nerve system of the feudal world. The great masses, however, remained illiterate. The mass media of the Middle Ages was the sermon (4). While the frontiers of the dynastical state formations changed continuously (5), it was the network of the Church that gave the peoples of the West a stable, organized framework.

It was *printing* that broke this frame. Press paved the way for Reformation and it had a lion's part in laicizing Europe (6). Just seventy years after Gutenberg, the leaflet, ancestor of the regular newspaper, became the new kind of mass media and it became the mightiest political weapon too. "My 95 theses were all over Germany in two weeks" says Luther (7). Until this time the simple serf possibly did not even know the name of his monarch, he knew, however, surely the name of his bishop. Soon he learned to what nation he belonged.

Feudal order, peasantry, royal power and bourgeoisie struggled for domination during centuries. Capitalism, the new economical and social order, was born in mutual action with the industrial revolution. It is customary to quote the steam-engine as the symbol of the latter. In our opinion the *telegraph* had more importance. Mature capitalism is unthinkable without the world market. No world market could have been born without the telegraph. And, of course, the telegraph would not have spread, had it not been for the needs of the world market.

The next milestone was something fundamentally new: the *telephone*. Not an instrument of further centralization, nor for announcing the orders, declarations, opinions of a higher power, but one for the dialogue of equal partners (8). This is a new, democratic form of communication (of course, first only for well-to-do social strata).

Radio and television are again unidirectional mass media. Undeniable the huge cultural revolution, they brought. They unify general taste, they give an intelligent content to free time, that great twentieth-century achievement of Labour Movement — they do not give, however, the possibility of a dialogue.

(As a short interjection we mention, that radio fulfilled for colonial peoples also the mission that has been fulfilled in Europe by printing: the awakening of national consciousness (9). But this step was only reached after the cheap transistorized radio, working with cheap batteries had spread all

over the underdeveloped continents. It is not yet recognized, how strong it influenced recent history.)

It was the technology of transistors that gave birth to microelectronics. To be more exact: microelectronics is the result of an organic development unifying processes of microphotography and printing with those of "classical" electronics. The essential fact is that it gives mankind a new possibility of information storage, of information processing, and of making decision based on information.

Our investigation is related to three different kinds of social change due to microelectronics.

Microelectronics and communications

In the field of communication proper the revolutionary change consists in abolishing the contradiction between unidirectional mass media and dialogue-enabling telephone (i.e. between authoritative and democratic communication). This is achieved through the birth of the new integrated interactive communication networks, made possible by the low cost of microelectronics (and by other results as well, like fibre technology etc.). The interactive network interweaves the whole society (10). Its terminals are there at every home, at every working place combining telephone set, screen and keyboard. It gives an ample selection of cultural programs, means for discussions and conferences without travel, availability of the most complete encyclopedia, containing day-to-day refreshed knowledge upon everything (stored, of course, in a huge central electronic memory), access to computer power, a possibility of forwarding letters, interactive games or of electronic commerce. France and Britain started already the construction of this new network; no doubt similar networks will work in many other countries the end of this century.

The society, the members of which are in such a connection with each other and also with a "collective brain", will be a highly organized society, organized at a level never achieved before. Clearly a revolution with consequences at least as far reaching as the consequences of printing. The latter, however, influenced first only an important but small layer of the population, while the interactive network may reach all members of society (11). Its effect will thus be even more general and more sudden.

Microelectronics and everyday life

The second revolution triggered by microelectronics is the one called sometimes "computer revolution". It is true, the principle of computers was known before. But the complex equipment built of pre-IC components was

clumsy, costly and not reliable. Nowadays computers become cheaper from year to year and at the same time they become more reliable, more perfect and more versatile.

Ten or fifteen years ago computers worked mostly for the centralized tasks of industry, science and commerce. This changed, however, with the advent of the microprocessor. According to its price and size the microprocessor is just a component. It is, however, the soul of the home personal computer. This small and easy-to-handle instrument brings computing power into the home, it accomplishes household and small-trade bookkeeping, engineering calculations, stores data and is a source of entertainment, too.

But microprocessors and other microelectronic devices are cheap enough to enter all fields of human activity. Even money will be partially substituted by a kind of electronic credit-card containing a simple microprocessor and a specialized memory. To draw our example from the field of public health, diagnostics undergo a revolution caused by computerized tomography, while in therapy electronic monitoring renders the intensive care of a great number of patients easy. Artificial organs, implantable drug delivery systems, protheses controlled by mutilated nerves help the invalid — all thanks to microelectronics.

In view of the wealth of recent popular contributions it is superfluous to discuss in detail the impact of microelectronics on education, on games for children and grown-ups, on fine arts, music, fiction, on office work (word processors, computerized translation etc.) on transport systems or such trivialities as household robots etc. (2, 12).

To sum up, our age sees a drastic transformation of the human way of life. In this point we find our historical analogy in the age of the industrial revolution.

Apart from a very small minority, the man of 1800 chopped his own firewood, his wife brought water from the village well, they travelled on a horse-driven cart. With water, gas or electricity in the house, with cheap, mass-produced goods and with railways he might have felt himself lost and alienated in 1900. Gone was his intimate contact with nature, he might have found himself in a man-made world. Similarly the man of 1950 might find himself lost and alienated in 1990. This time it would be his personal contact with other people during his every-day routine that would be missing. His partner would be mostly a machine.

But—instead of "would" we have to use the verb "will", since 40 years are well within the lifespan of the individual. Man's ability of adaptation will be gravely challenged.

Microelectronics and labour

We come now to the most important consequence of the spread of microelectronics. This is the employment problem. We know that microprocessor-controlled robots, programmable machines with ability for sensing and decision-making, can do the greater part of human jobs in each sector of national economy. The logical consequence seems to be mass unemployment. Again, examples are too well-known to be quoted here. We mention only an unmanned plant in Japan where FMS (flexible machining system) units — i.e. computer controlled programmable machine tools, combined with transfer devices — reproduce themselves (13).

No part of the world can keep itself out of the consequences of this process, but these consequences will be different. In highly developed countries there will be a transition period. During this the new technology itself will open new job possibilities in certain categories. (R and D, software, stc.) In countries like Hungary, the automation of the service sector will not follow immediately the automation in production, and so manpower set free in the latter sector might be absorbed for a time by the former. Developing countries will be hit the hardest and the most immediately.

But sooner or later every country has to undergo a vast social crisis. No doubt, mankind will ultimately find a solution. A radically new social order will emerge.

We think that something will be changed in this new society, something unchanged during past chapters of written history: the relation of mankind to labour. Ever since the Neolithic Revolution, regular labour, whether on the field, as in past millennia, in factories as in the nineteenth century, or at the office desk as for many of us nowadays, was the main content of human life. It is this tight bond that will loosen in the new age. The image of a society not bound to labour is still something for sci-fi authors, but sociology begins already to deal with its outlines (14, 15). One thing is certain: this will be one of the greatest revolutionary turning points in human civilization. It is in this respect that we might consider the impact of microelectronics as an inversion of the Neolithic Revolution.

As above, we have again to remark, that this time it will not be a series of innumerable generations that will slowly change their habits but a single generation — presumably the next one.

Summing up: microelectronics gives society a more developed form of organization; on the other hand it endangers certain human contacts; in perspective it relieves a great part of human life from the obligation of labour.

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