The Sections of Contemporary Technological Society

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1. CULTURE AND CIVILIZATION

Civilization is the history of human beings in search of a better life, setting to work to alter nature, enjoying the fruits of their efforts, and further improving on them. Tools were fashioned from things close at hand, and through a gradual process of improvement, advanced technology was created. In one sense, we may say that civilization is the history of technology.

Civilizations were built up by groups and nations of people who share identities as belonging together. Each of those groups has in common certain customs and ways of thinking. Those are culture. The tools and techniques used by the various groups differ according to their varied living environments and historical circumstances. It is culture that governs such usage. There are things that are quite similar even though they originate in different places. Some things that have been transmitted from one area to another, others been created originally in different places, and others been created in more than one places after the transmission of relevant information.

Very similar civilizations have been created by different cultures. In the life of a nation, culture and civilization are entirely different ideas, but in thinking about technology it is impossible to separate the two. However, culture is something that cannot directly be seen. It has the characteristic of not being comprehensible except through civilization. Moreover, since civilizations that appear the same may be created differently by different cultures, it is difficult to understand culture through civilization. Accordingly, although cultural theory is liable to slip into abstract discussion, it always deserves consideration as a driving force of civilization.

2. TECHNOLOGY AND SCIENCE

What we call "science" is an idea that was born in Europe around the 17th century. It is regarded as something that quenches human curiosity about topics concerning celestial bodies or the natural phenomena of biology, physics and chemistry. Thus it is concerned with the perception of nature and the discovery of new facts. However, interest in phenomena that are unaffected by humans, and why they are as they are, has run throughout human history. Various nations have varying interpretations.

In the broad sense, science deals with phenomena in a systematic fashion, convinces many people, and serves as a font of common knowledge. It is by no means limited to natural phenomena. Human society is also its subject. We might think of facts as something universal; but since the filter of human consciousness intervenes, there are cultural differences. Hence "Ethno-science" exists as a discipline.

Technology, on the other hand, refers to the means for achieving specified goals. It is related to discovery and originality. After the key step of setting the purpose, one seeks to find out what sort of device can achieve it. Here is where originality comes into play. Technology developed along with the birth of humans and created various tools, and then made very rapid further progress with the development of science.

Science and technology are ideas which differ to the same extent as culture and civilization, and which are liable to become confused with them. Even without scientific knowledge, it is possible to develop technology to accomplish a certain aim. Yet there are also things like alchemy which, since they are theoretically impossible, cannot be achieved regardless of what devices are applied. Through knowledge backed by science, it is possible to develop new technology with confidence.

Meanwhile, tools are necessary for the furtherance of scientific knowledge. Science and technology progress by supplementing each other concerning problems on the micro and the macro levels, as with telescopes for astronomical measurements, microscopes for observing microorganisms, or accelerators for studying atoms and their particles. Hence it is difficult to accurately distinguish between the two, and we often resort to the rather vague locution, "science and technology."

3. THE FEATURES OF CONTEMPORARY SOCIETY

There are some four to five thousand ethnically distinct nations living on the earth. Their societies have civilizations of diverse extent. The main flow of civilization is the transformation from hunting-and-gathering society, through agricultural society and industrial society, to informational society. Although every society does not necessarily pass through these stages, Japan has done so and today is approaching the stage of informational society. Farming and industry exist in a multilayered context that includes the industrialization of agriculture and the informationization of industry. In informationization, the USA is a step ahead, but for Europe the situation seems somewhat different. There the industrial revolution, as a revolution of motive power, was quite rapidly accomplished, but in the information revolution the region appears to be on the conservative side.

To help us think about the civilization of Japanese society, and especially the topic of technology, we may define the surrounding social conditions in terms of the following special characteristics.

1. Informationization
2. Systemization
3. Internationalization
4. Humanization
5. Popularization
6. Segmentation

All of these have arisen along with informationization, which comprises a shift toward a different value system from that of the previous society.

Systemization is a situation in which close connections come into being among various affairs in a society, and it is no longer possible to deal with them in simple terms. A change in one area will exert major influence on the other elements. There is a Japanese saying, "If the wind blows, the cooper profits." This means, "If a strong wind blew, many people suffered pain in their eyes because of dust, and became blind. These people would start working as shamisen players. The shamisen is a Japanese musical string instrument with cats' skin, and lots of cats were killed to make enough shamisens. Without cats, mice increased in number and ate wooden tubs to reach food. Therefore new tubs sold well and coopers made profits." This has traditionally stood as an example of strained logic, but today such connections actually occur. Hence we cannot adequately respond without carefully recognizing the connections among systems and the structure of networks.

The systems and the networks do not pertain exclusively to Japanese internal affairs, for they have also become closely geared to the rest of the world. This is due to the development of telecommunications and transportation networks. We are able to watch the actual situation in a war that happens in a far distant region. We can send printed matter via facsimile machines. Contemporary technology makes it possible to overcome space and time. Of course there are many societies which do not enjoy such benefits. Some societies reject them as a question of values, but it is more often the case that economic barriers prevent their realization.

Movement in the direction of humanization is possible. In the early phase of industrialization, machines were central. Whereas in previous manufacturing, priority was given to efficiency and homogeneity, the perspective is now changing toward manufacturing which fulfills user needs and takes aesthetics into account. In mechanical design also, what is sought now is not engineering efficiency, but user-friendly interface design. The computer world, too, is now changing toward the view that the user should not be required to study a manual, but instead that anyone should be able to use a product without background knowledge. However, in most cases that goal has not yet been satisfied.

The next point is somewhat similar: popularization is advancing. That is to say that where the previous industrial society reserved leadership for the producer, the option has shifted to the end user. There has been a change from the previous top-down thinking to a bottom-up approach. In industrial production, there is a shift from uniform production of a few models in large quantities, to the production of many models in small quantities, with abundant variation to fit individual needs. This trend is not limited to production, but can also be seen in politics, business management and other areas of our lives.

With the very rapid change in contemporary technology, there are segments where the technology of the moment cannot effectively be applied. To put it the other way around, those who are well matched to a technology that appears at just the right moment will enjoy it, and they comprise a discrete group. People who reached the prime of life before computers appeared have not become comfortable with them. Very rapid technological innovation may be cited as one of the factors that caused generation gaps. That very speed is now on the verge of becoming a problem. Humans, being living organisms, have lost the ability to keep up.

The recent tendency of young, talented personnel to stay out of manufacturing industry has become a problem. Those who are graduated in physics or engineering, with their strong skills in mathematics and computers, gravitate not to the so-called makers, but instead to such sectors as finance. This is not especially surprising. The constitution of the financial industry has changed from what it used to be. Aviation, railways and publishing are also internally affected by informationization. Of course there are many informationized aspects in manufacturing industries as well, but the degree of specialization is quite different from other fields.

Naturally a world where information means nothing more than computers and telecommunications will slip quickly into idleness. Although a short poem might shake the world, scores of reports are still not worth a single look, for objects speak volumes by way of information. If informationized manufacturing moves too far away from objects, it will in time be abandoned.

In the future the wave of information will penetrate still more widely. There was a time when the computer was operated by a specialist, but just as it is now diffusing into the average household, from now on it will penetrate further in various fields. Life becomes convenient, and objects and information become abundant—such is the progress of civilization. Yet on the other hand, more and more people are suffering from stress because they are unable to keep up with those changes.

As the next problem for the informationized society, the focus is shifting to the question of how to live with peace of mind. In other words, the informationized society will be followed by a society that seeks spiritual security. In vernacular terms, this would be a happy society, or a tranquil society. We may hope for the emergence of a sensitive society, in which each person can live with full individuality, based on a balance between objects and information.

4. CULTURAL CHARATERISTICS OF THE JAPANESE MODEL OF TECHNOLOGY

By what means was the development of present-day Japanese technology accomplished? In terms of economics as well as of industrial technology, Japan has taken a position in the world's top group. Just how did this come about? The nations of the world are mystified. The Asian nations in particular are wondering why Japan is the only one out ahead, and they want to know the secret.

Yet this riddle cannot be solved only by looking at postwar development. It is necessary to search back through history for the causes.

In the West it is thought that Japan's prosperity resulted from its adoption of European civilization during the Meiji period, but is that really so? Certainly we have learned many things from European civilization. On the surface, it is clear that various elements were imported from England, France, Germany and elsewhere. Since World War II, various things have been brought in from America. Thus the present-day growth of Japan does indeed owe much to Europe and America. Yet there must have been some previously existing groundwork which enabled the society to accept new things. From approximately what point in time was that groundwork cultivated?

In the development of a civilization, a major contribution is made by the way of thinking of the nation which sustains it, in other words, by cultural characteristics. What might be the differences between the cultures of the Asian nations and that of Japan? How are we to explain the parallel phenomena that occur in the civilizations of Japan and the West?

One approach to answering those questions is to seek the factors of success within the value sense and national characteristics that are peculiar to the Japanese. This approach is not without its critics, who claim that it is merely superficial folklore and conjecture, without scholarly substantiation. It is not advisable to propose an overly simplistic theory of Japanese culture and develop a theory of Japanese uniqueness. Yet from the standpoint of cultural comparison, even thinking conservatively, it is impossible to deny that the common foundation within Japanese society has distinctive features that differ somewhat from other societies.

One of the characteristic elements of Japanese society is its modality of information. The "tacit understanding" that takes place among concerned parties plays an extremely important role. It comprises a common ground. There are things that are mutually understood over and above the information that is outwardly expressed by talking or writing, and these govern people's speech and behavior.

It involves aspects which are formed from the overall ground called Japan, and aspects which are made up from the partial sectional ground of the family (*ie*), native region, alma mater or company. Furthermore, each of those has a differing quality. It is generated from the atmosphere of the ground in a gradual process, and the matter of comprehension is not precise. Even many Japanese cannot explain specifically how this works. Naturally it is difficult to understand for the foreigner with no experience of living with it. This is one of the reasons why Japan is a country that is difficult to understand.

Japanese society is said to be governed by the principle of interpersonalism, because it is organized on the basis of such unseen, tacit information which exists between one person and another. Naturally in countries other than Japan, some types of tacit understanding also exist, but in Japan's case its extent is quite large.

This may be because, on the whole, Japanese society possesses a relatively uniform culture. Further, it may be that the close personal proximity in Japan's dense living spaces promoted the formation of a uniform culture. Recently, however, with the development of mass broadcast and print media, information channels have diversified and substantial spatial and generational differences are being generated. This has caused perceptible change, so that the understanding may no longer be completely smooth, and yet it remains deeply rooted as a kind of background atmosphere of Japanese society.

The term "interpersonalism" has been used by HAMAGUCHI Eshun and others to describe a society that has this type of human relations. Interpersonal relations among individuals are consolidated through invisible bonds, and it is troublesome for individuals to cut those bonds and stick out. There are ways in which this functions to advantage, and ways in which it functions to disadvantage. It has the merit of imparting a sense of stability by placing everyone at the same level, neither elevating some to distant superiority nor leaving others out. It has such demerits as making new things difficult and hampering the emergence of outstanding persons.

The well-known Japanese proverb, "The nail that sticks up gets hammered down," is a clear statement of the fact that priority is given not to the individual but to the social order. This way of thinking places importance on the organization. Interpersonalism keeps everyone at approximately the same level, and as a result, significant differences among individuals do not tend to emerge in educational, economic and governmental structures.

Interpersonalism operates through a mechanism that differs from that of egalitarianism. Rather than the perception that everyone is equal, it is a structure in which there is an equality of results due to the bonds between one person and another. Even if one behaves in an individualistic manner, in the end it is impossible to escape from these bonds.

5. IMITATION AND ORIGINALITY

Japan's technology has reached the top class in world terms. This appears to be a post-World War II phenomenon, but its roots are old. In the early period influences were received from Chinese civilization, and yet a civilization different from China was erected. Civilization from the West was also imported, but a civilization different from the West was created. In the cultural backdrop to that accomplishment, there has been a pursuit of technology for technology's sake. Thoroughgoing ingenious improvement is a distinctive feature of the Japanese model of technology. It is a world not exclusively of Western-style rational judgment, but of sensitivity based on aesthetics. This may be only one of the reasons for the success of Japanese technology, but it is an important quality.

Such a society is weak in prominent activities like invention or the discovery of new subjects, but once an objective is defined, there is competition to reach it. Interpersonalism comprises a competitive society in which mutual rivalry is stimulated on the unconscious level. This is true among individuals and corporate organizations alike.

This casts doubt on appraisals from other countries that the Japanese lack originality and engage in imitation. Is that supposed to be in the area of science or in the area of technology? In the setting of goals or in the methods of attaining them? It is true that in the setting of goals or in the making creative idea within modern technology, Japan is somewhat inferior to European countries and U.S.A. Yet in methods of attainment it is by no means inferior and originality is not lacking. It seems instead that in that respect Japan is relatively superior to others.

Perhaps the originality of discovery and invention is indeed low. However, there is superiority in the ability to combine elements effectively and invent things with new functions. This is one type of originality. Moreover, where there is imitation, it always involves ingenious improvement. It seems that there has been no recognition or advocacy of that element.

There are many cases of complaints from Europe and America about patent infringement by Japanese companies. While it is necessary to carefully examine the circumstances pertaining to specific cases, the general question arises, is it actually imitation, or has a unique device been added while using the original form as a model? This should be calmly debated, separating legal issues from technological issues.

In fields related to electronics there have been many outstanding achievements in Japan. As to whether there has been recognition of this from society, unfortunately the answer seems to be negative. It seems that with the custom of coveting Western things, even when original things are germinated in Japan, in most cases they are ignored. Both individual and group behavior must be considered. If we consider Chinese civilization, we will likely find similar social aspects in the definition of new technological developments.

Japan's success in the field of electronics was based on a fervent competitiveness that might even be called irrational. The success of semiconductor factories was said to depend on the quality of the clean rooms, where extraordinary care was taken to produce environments with extremely low levels of dust. In America they were designed on the basis of rational, theoretical judgment, but sometimes with unfortunate results.

In the design of integrated circuits, as well, the basic idea was American, but Japan has now surpassed America in increasing the density of the integration. It is behind in the development of logic circuits with new functions, but superior when it comes to the technology for their actual realization. The same can be said for the quality control movement. The idea itself was imported from America, but it was implemented more thoroughly than on its original ground, and led to improved productivity and cost efficiency.

We may take the case of computers as a typical case of the development of Japanese contemporary technology. When did computers originate? Let us briefly review the history to clarify the time sequence. Machines that use punchcards to aggregate statistical data date from the beginning of the 20th century. Those were so-called single-purpose machines, capable only of handling statistics. The advance to automatic, programmed operation came around the end of World War II with the completion in America of ENIAC in 1946. In Europe, similar research was under way at about the same time. That was electronics using vacuum tubes, with programs not yet built in. The prototypes of the contemporary, so-called von Neumann-type computer appeared from 1951.

In Japan research had already been done on elemental electronic circuit technology, but no thought had been given to the computer as a system. Due in part to wartime circumstances, research data from America was not obtained. After the war, original experimental research began on the basis of hints taken from articles about ENIAC that appeared in general magazines. Yet it was only from about 1960 that computers began operating in Japan on a practical level.

A Society of Information Management was established in Japan in April 1960. At that time the word "information" was not in such general use as it is today, and various names were considered for the society. Such ideas as "knowledge industry" or "information industry" also appeared around that time. It is from then that the adoption of computers began to spread, and developments in telecommunications technology and its linkage with computers led to new changes in society. During the past 30 years, we have seen remarkable advances in such fields as broadcasting, publishing, telecommunications, research and education, and production technology. Informationization has rapidly evolved, especially in America and Japan. We have reached a point of no return to the previously existing world. Such things as power outages, interruptions of bullet-train service, or mishaps in online banking systems cause great inconvenience to our daily lives.

6. NON-NATIONALITY AND TECHNOLOGY TRANSFER

It is possible to think that when technology reaches advanced levels, it moves beyond the state of strong linkage with national cultures, taking on a universality that does not depend on culture. While this may be true for something that serves a simple function, in cases where other things become necessary, they must all be taken as a single set. For example, if there are automobiles, then gasoline is necessary for their operation. Spare parts for maintenance are also needed. Is the society prepared to the point of having the peripheral commodities on hand? Has the society reached a condition of maturity sufficient to absorb the supporting technologies? The basic question is, what sorts of conditions are sufficient to enable the transfer of technology?

Through the development of telecommunications and transport on an international scale, information and materials become communalized, and we face the possibility that the whole world will become entirely the same. What are we to make of that? The loss of national identity in leading-edge technologies and its implications for culture constitute a fascinating topic. There are technologies which are moving beyond cultures and technologies which are not. Or perhaps leading-edge technology will transform culture.

The development of technology necessitates standardization. For a screw or an electric outlet, even for mechanical components, widespread use is impossible without similar standards for production anywhere. Accordingly, in most cases uniform standards have been set for basic parts. Yet when it comes to the commoditization of systems, we find that diverse characteristics emerge.

In television broadcasting, for example, there are three different formats around the world. Japan and America use NTSC, Europe uses PAL, and the Eastern European region uses SECOM. Video formats differ accordingly. A tape recorded in the NTSC format cannot be played on a PAL machine. Since this is a very important means of communication for what we might call the broadcasting nations, there has been a historical process in which respective original developments were carried out, leading to the creation of different formats. Countries in which original development was not possible have introduced one or another of them according to political and economic circumstances.

This has also made a mark on high-definition television, which has recently been a subject of controversy. Japan has a 20-year history of research in high-definition technology, and has brought the technology to the forefront. For technology transfer, the West would be fertile soil. However, due to the development of original formats in America and Europe, standardization was not possible. This has some connection with existing television formats, but it is clear that nationalism is also operating strongly.

Compatibility and standardization are also problems in the world of computers. Nowadays it is common knowledge that an operating system (OS) is necessary to run a computer; but until about the mid-1960s, it was necessary for the user to directly input a program. The idea of having an OS to improve the human-machine interface is still rather new. The OS differs according to the machine used. This applies not only to very large units but to personal computers as well. If the OS is different, the method of use will also be different. The ideal situation would be for the user to be able to operate a computer without thinking about such things as the OS, but this is not yet the case.

This is also true for programming languages. At the beginning it was necessary to directly write commands resembling the code that the machine could directly understand. Things became much easier with the development of languages written in expressions approximating English. There are many types, such as COBOL, FORTRAN, BASIC, PL/1 and Pascal, but at any rate there is a standard grammar for all of them. Consequently, it ought to be possible for a program to run on any machine that has software (a compiler) for interpreting the language. Yet that is not the actual case. The various compilers accept their respective dialects. The computer manufacturers permit non-standard original expressions for the sake of user convenience. If a program is written with such expressions, it cannot be understood by other machines. It must be written all over again. Thus while standardization has been achieved, compatibility has not been maintained.

There are also problems when different machines are connected and data exchanged between them. Data can be sent if both programs are written with protocols that are very similar to the hardware, but there used to be no easy method of transmission. Now a standard, called open systems interconnection, is being promoted as a uniform protocol by which data can be sent and received without the user having to worry about the hardware. It is further necessary to bring about conformance in the area of data formats. Commonality must be achieved for the tags that clarify how the data is structured and what each part expresses. However, the prior problem of standardizing the character codes handled by computers has not yet been solved. Languages using many characters, such as Japanese or Chinese, have different modes of thinking than languages in which a small number of alphabetic characters suffice. As the West has led the way so far, alphabet-based code systems have predominated, but for the sake of users in various linguistic spheres, there are many issues of this sort that demand future attention.

In the world of computers, then, there are areas where standardization has progressed, and areas that are still subject to drag from the past. To facilitate technology transfer and the non-nationality of technology, the problems of standardization and conformity must be resolved.

7. TECHNOLOGY AND ECONOMY

Great sums of money are necessary for the development and diffusion of leading-edge technologies. Technology transfer is not merely a question of technology, for naturally it is strongly related to the social economies that support it. It is often said that technological progress has strong connections to the military sector. Technologies that support the development of new weapons, the installation of information networks, and society-wide infrastructures advance through the exercise of state power. It is undeniable that leading-edge technologies have been promoted by the governments of America and the former Soviet Union. However, if military affairs receive undue priority, the result may be that the development of other, general-use technologies is neglected.

The leading-edge technologies of Japan were propelled entirely by the private sector, and that has led to today's success. The difference between the military sector and the private sector is reflected in attitudes toward return on investment and quality control in production. For military procurement, the supply of a small quantity is enough. Quality is demanded, but cost is not much of a problem. In the private sector, success requires a small profit margin and quick return. Inevitably, ways must be found to increase returns and produce cheaply. This is where appropriate competition is undertaken with respect to technology.

From the standpoint of economics, there is a big difference between the skill of an artisan and modern industrial technology. It is the difference between the situation where it is enough to make a small quantity of goods and obtain income to meet an individual's needs, and the situation of an enterprise that utilizes many people to fabricate a large quantity of goods in hopes of obtaining greater returns. Even when there is a good idea and good technology, the key to making them work is the amount of capital that can be invested.

In contemporary Japan, there are many enterprises with funding power that is not inferior to America. Japan has sufficient potential to develop a new civilization by bringing this capital power to bear on gigantic technologies. However, as the recent bubble phenomenon makes clear, a great danger is presented by managers who pursue only individual profits. From a global standpoint, humanity requires a conception of investment for effective civilization.

8. TOWARD IMPROVED SOCIAL SYSTEMS

How will the technology of Japan develop in the future? The things that are considered essential technologies are likely in 30 years' time to have progressed beyond what we can imagine. The emergence of new materials, increases in LSI density and performance, high-speed computers based on new processes, high-speed image and graphic functions that anyone can easily perform, the evolution of electronic devices, large-scale multimedia databases, and so forth. We may also be certain that those will be used in new ways that will have great impacts on society, such as devices for pattern recognition and language comprehension, regionalized networks, cashless systems and high-speed traffic networks.

Looking back at the past 30 years, regardless of the developments in computer and telecommunications technologies, if we ask how our lives have changed compared to a few centuries ago, we can say they have changed greatly, and on the contrary they have not changed.

Life has indeed become more convenient in many respects. Yet on the other hand, even without television and newspapers and magazines, or even without automobiles, a life that feels not at all inconvenient still exists. Undeniably, of course, since our lives are in a high-tech environment, we benefit indirectly from its conveniences. Yet it is also true that the pursuit of convenience and the pursuit of efficiency are not necessarily connected to fullness of the content of life.

Although information processing to date has pursued the goals of making various aspects of human life faster and more efficient, the direction in which we must aim is rather that of creating a society where we individuals may live with greater satisfaction, spiritual fulfillment and a sense of ease. The next 30 years will be a period of change of direction.

Here I would like to suggest two or three topics on which we must carry out development with international cooperation in the future.

1) Making Weather Engineering a Reality

Climate and weather are areas with which we are very deeply concerned. Nevertheless, we are resigned to weather forecasts that are sometimes incorrect. Of course this is an extremely difficult topic. We do not yet understand its essential workings on the local level, much less on the global scale.

At present, predictions have become possible to a fair degree through the use of observation satellites and computers, but there is still a long way to go. Despite the extreme importance of the problems of weather and earthquakes, up to now they have not constituted any sort of special discipline, and have not attracted outstanding people from the field of information engineering. Investigation of the physical aspects of natural phenomena in the fields of astronomy and meteorology is not enough. It cannot be realized without major efforts in joint research by specialists in such areas as computer simulation and high-speed calculation technology. Rather than simple prediction, we should be thinking about positively utilizing the forces of nature, for example, generating electrical power from typhoons or from intense heat.

2) From Organ Transplants to Artificial Organs

Lately, the transplantation of organs has begun to flourish in Japan. As a result the concept of brain death has emerged and generated considerable controversy. As an individual, I am opposed to organ transplants. The heart and liver are crucial organs for a human being, and the idea of having such a part of another person inside myself, or part of myself inside another person offends my sensibilities. We can transplant everything and make a patchwork person, and then just who is that person? An individual's biological life should be completed as an individual. A person has a destiny, and a lifespan.

For those with defective organs who still want to live, we should develop artificial devices. It will involve extremely difficult problems, but medicine and information engineering should collaborate and aim for it. Rather than petty artificial intelligence, we should be researching the genuine mechanisms of life. Some people are convinced it will lead to steel-limbed humanoid robots such as we see in popular science fiction. The choice will be theirs.

3) Promoting Health Information Engineering

Modern medicine tends to rely on medications and measuring instruments. Rather than inserting foreign objects into the human body, we could infer what is happening inside the body from the outside, as with a CT scan. We could undertake a large-scale program to gather data from regular measurements of many people's skin color, palm prints and blood pressure, plus data from their medical examinations, and create a general database for use in inferring changes in the body from outward signs. I understand that images of palm prints are already being collected in great numbers and their changes are being analyzed to clarify the relationships with health.

Furthermore, there are reportedly many points on the soles of the feet and on the hands which are connected to internal organs. Yet it seems that our knowledge about that is at the same level as our weather reports. This area deserves to be elucidated through a serious research program involving a substantial number of researchers in information science and in Western and Oriental medicine.

9. THE SHADOW OF CONTEMPORARY TECHNOLOGICAL SOCIETY

While it is true that life has become convenient through progress in technology, it is also true that in its wake have appeared problems which did not exist before. Along with industrial development have come such things as "pollution" and "environmental destruction." There are aspects that have improved with the appearance of computers, there are many light sides, and obviously there are also dark sides.

In terms of the way computers work, there are things that are possible and things that are not. This is obvious, but even the areas that are deemed possible are not without problems.

With systems that incorporate computers, the most dreaded thing is the problem of control under abnormal conditions that were not envisioned beforehand. Abnormal conditions will of course occur, and what do we do then? If this is not handled adequately it can become something quite serious. Consider the controls of nuclear reactors, or of airplanes or huge factory equipment. Medical treatment is also informationized. When these things run normally they are quite fine, but what about the times when they do not?

If we leave such things to the judgment of the computer itself, it is necessary to input enormous amounts of data. Data concerning exceptional events can reach absurd levels. It would be an awesome job to be thoroughly comprehensive, covering this, that and every other case. Usually, the scenarios considered are limited to the range of reasonable expectation. But what is to be done when something unimagined happens? The means for the coexistence of humans and machines is an important issue.

So-called expert systems and artificial-intelligence systems are being developed, but at present they have not moved past the immature stage. That is because the rich intelligence possessed by human beings cannot yet be well expressed in the world of objective signals. In order to improve computers it will be necessary to conduct much more study of the brain activity of human beings.

A number of new social problems arose with the arrival of the computer. In most cases they involve not computer error, but human error, on the part of someone handling the operation of the computer. There are cases where damage results from an operating error in a computerized system. Substantial sums of money are frequently paid out through unnoticed errors in data input. There are also cases of wanton misuse. Crimes that occur in financial institutions are mostly crimes by insiders rather than computer defects, and we lack experience in many aspects of the problem of safeguarding against such incidents.

Moreover, as informationization advances, various databases are created and personal information is entered into computers. This is convenient, but it creates problems concerning violations of privacy. There are cases in which personal information was input without the knowledge of the person concerned, and then used for other purposes. Once some inaccurate personal information is input, it can take on a life of its own and can cause damage. The resulting problems may affect such things as family records or credit ratings. One way to resolve those problems would be to appeal to social morality. Yet we must also use technology to endeavor to prevent them in advance. That will no doubt tax human wisdom to the limit. It is a problem that must be resolved in the future.

Computerization is increasingly moving into many new areas. Computers themselves are taking on more flexible capabilities, turning into multimedia systems that can freely handle not only words and numbers, but images and sounds as well. Through the development of neurocomputers that use methods closely resembling the processes of human perception, functions such as character recognition and mechanical translation have evolved to levels approaching practical use.

Civilization has definitely advanced, but what rating should it receive in terms of the degree of satisfaction in people's lives? In the future we must change direction, away from the handling of objects, and toward an industrial revolution that seeks spiritual satisfaction.