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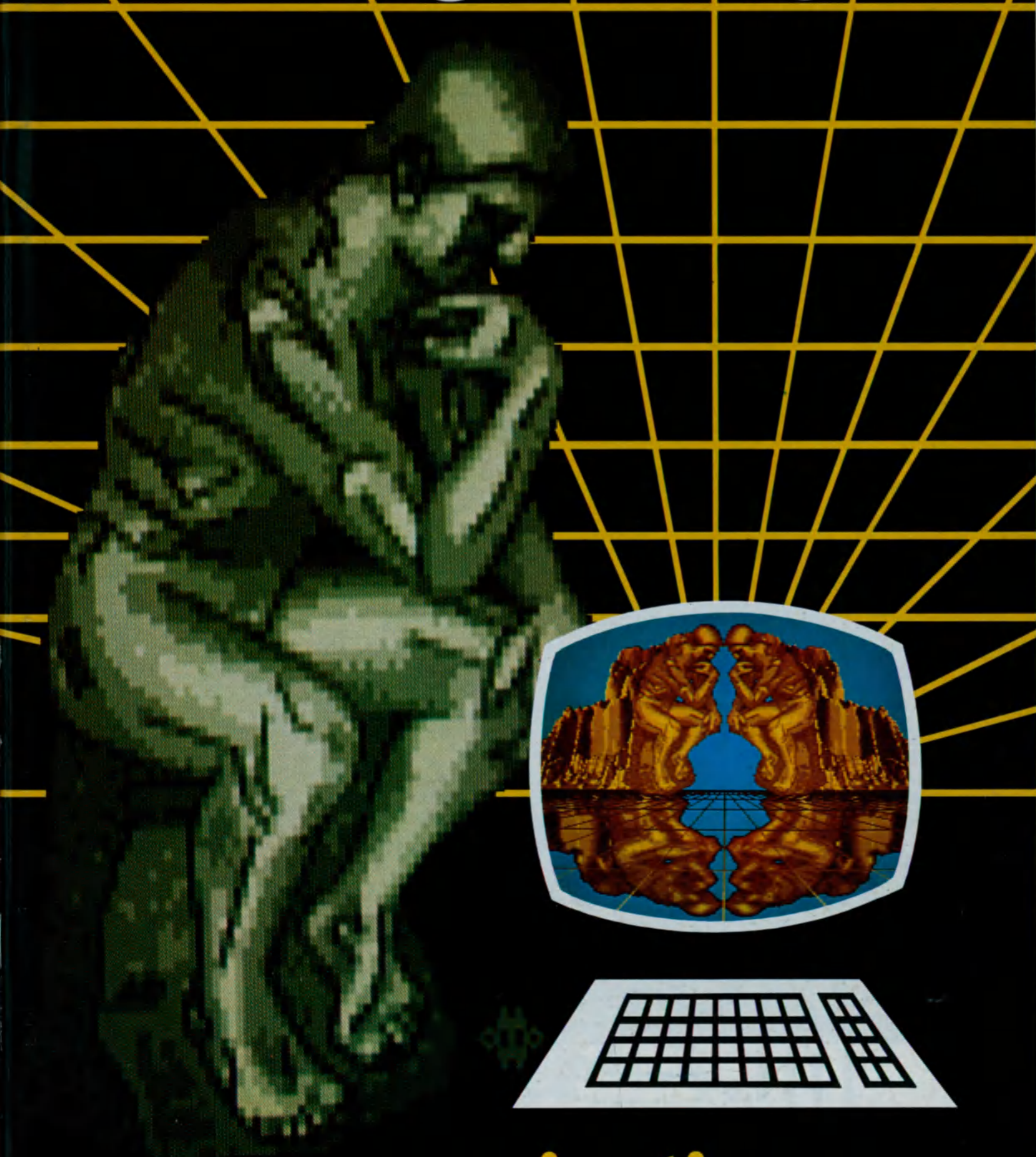

communications

A time to live...

Photo © Japan National Tourist Organization, Paris

⓫ JAPAN **House of snow**

Each year in February, children in the north of the island of Honshu, Japan, build *kamakura*, or houses of snow, in which they play, hold parties, cook food and eat rice cakes. This ancient custom undoubtedly has a religious origin; each snow house has its shrine, traditionally dedicated to the god of water, on which the children place offerings.

The Unesco Courier

A window open on the world

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Editorial

THE beginning of World Communications Year finds us living through a communications-information revolution with profound implications for every aspect of human society. Our homes, schools and hospitals, our cultural and leisure activities, the working environment of office, farm and factory, the very concept of "work" itself, will all be radically transformed before the century is out. So far-reaching do these transformations promise to be that historians of the future are likely to look back on the present decade as a turning point in the evolution of human society.

Smooth transition to the new information-rich, communications-based society will not be easy. The way we handle the new communications technologies will be all important and it is with an analysis of the cultural, social, economic and political problems involved that this issue of the Unesco Courier *begins.*

For the Third World, the establishment of sound communications infrastructures (which it is the prime objective of the World Communications Year to promote) is a sine qua non *of development. But although the new technologies look temptingly like the breakthrough that could help to close the development gap, it is only natural that, for countries that have suffered the colonial experience, hopes for the future should be mingled with serious doubts and fears.*

The central section of this issue is concerned with the electronic "nuts and bolts" of the communications-information revolution which has been brought about by the rapid convergence of a number of new technologies. The most important of these are: the development of cheap, reliable microprocessors with vast information-handling capacity which permit widespread and easy access to information networks and data banks and offer enormous educational opportunities; telecommunication satellites that make possible low-cost, long-range transmissions; audiovisual recording and playback devices that permit decentralized production and presentation of multimedia material; the development of optical fibres which make possible piped, interference-free transmission of huge quantities of information, entertainment and educational programmes; and, finally, the expansion and more efficient use of the broadcasting frequency spectrum which has made possible the rapid development of local and "citizens' band" type radio broadcasting.

Experience shows that children all over the world, whatever their social background are fascinated by computers and can handle with ease a device which many adults still regard with a reticence bordering on fear.

The computer's educational possibilities are immense, provided that it is programmed to respect the user's linguistic background and cultural identity, a point on which children themselves have strong views.

Finally, the last section of this issue of the Unesco Courier *looks more closely at the practical contribution communications technology can make to development, points out some of the pitfalls to be avoided in what looks like being the most massive transfer of technology ever attempted, and gives concrete examples of what Unesco has done and is doing in the struggle to introduce a new and more equitable international communication order.*

Cover: computer-assisted design by Mowgli, Atelier Visconti-Lactamme, Paris

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We must work together to enable the modern communication media to contribute increasingly to the flowering of freedom and to the development of mutual understanding and respect among nations, as well as to the promotion of general social progress within each nation.

Amadou-Mahtar M'Bow
Director-General of Unesco

Communication in the service of man

INFORMATION has become a key resource. The industrial society whose hallmark has for long been man's power over things and over nature also seems to be on the way to becoming what some have called the information society, characterized by an enormous increase in man's power to extend, store and order his knowledge, to produce information and disseminate it instantaneously, and the capacity to create organizations that encompass all aspects of life in society. Information has always been a fundamental element in human organization and the cohesion of societies, and the information revolution has far-reaching consequences, in the more or less long term, for social organization.

The close relationship between communication and all types of power, the importance of communication as a source of wealth, at national and at world level, together with the influence that it exerts on the various societies and on international relations, go a long way towards explaining the scope and intensity of the debate on the subject. At national level, the division of responsibilities between the public and private sectors, the place allotted to the press, broadcasting and the cinema, the status of journalists and other professional communicators, the influence that they exert in different ways and, in particular, the impact of certain televised and cinematographic messages and publications, particularly on the minds of inexperienced young people, are the subject of continual discussion in many countries. The same problems recur at international level.

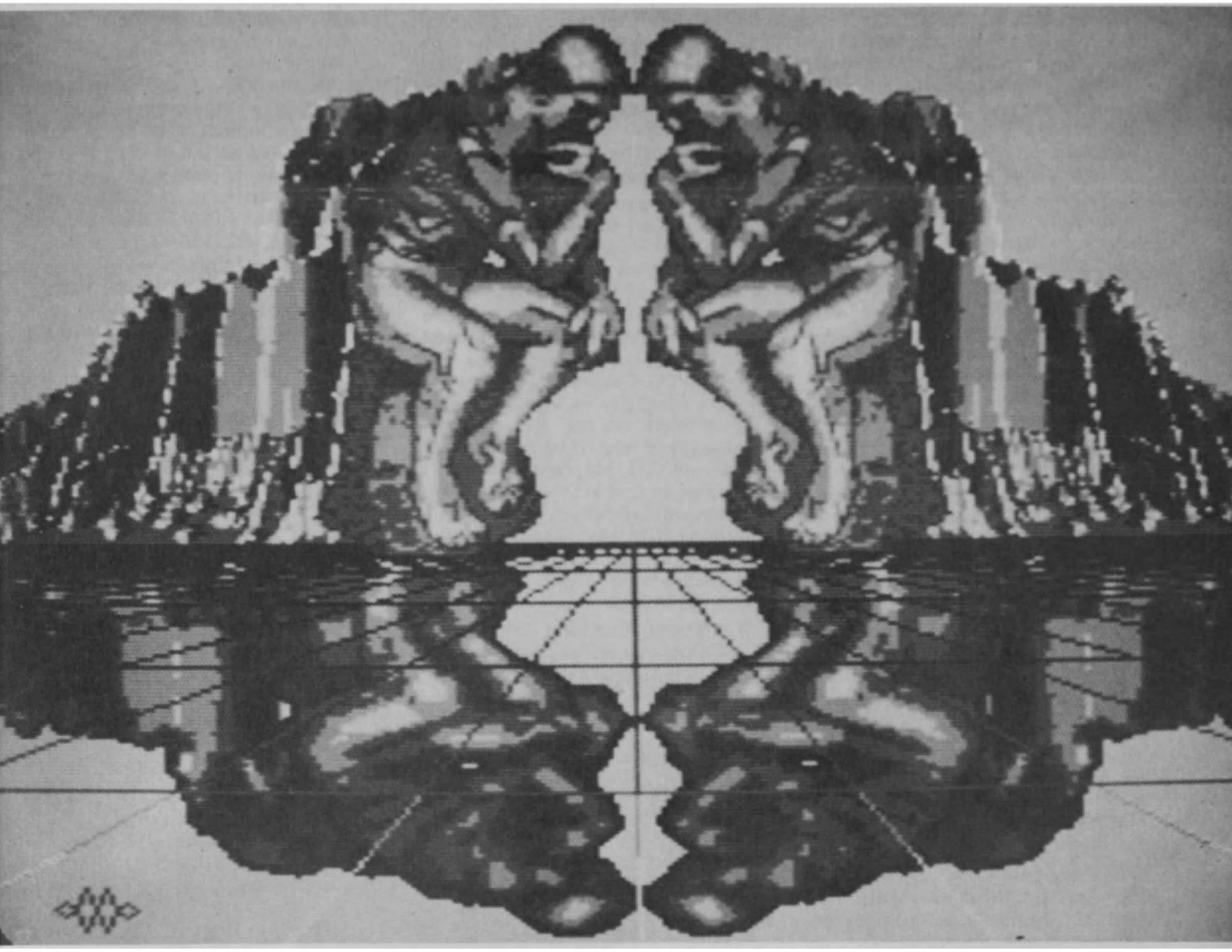
Modern telecommunication technology enables those with access thereto to broadcast messages which can be received instantaneously throughout the world. Thanks to communications satellites, this is already true of radio, and will soon be so for television. However, the electromagnetic spectrum still remains very unequally distributed, and few countries have the means of developing or even benefiting from the appropriate technologies.

The impact that the messages transmitted by this means can have on mutual understanding between peoples and between nations and on the maintenance of peace is undeniable. Clearly, then, the international community cannot ignore the problem of the content of these messages, which are potentially of the gravest significance for the future development of peoples and indeed of all mankind. This is why mankind has always attached importance to the role that the media play, or can potentially play, in eliminating prejudice and helping to bring about a world where mutual understanding will hasten the coming of peace and the advent of societies that are more just, more respectful of human rights, and more concerned to do away with ignorance, disease, hunger and poverty.

The development of the cultural and the communications industries may encourage a dialogue serving to promote better understanding between peoples and their cultures, but it may also lead to serious forms of cultural alienation if these industries remain concentrated solely in certain areas of the world, if the products and the messages which they create are typical only of certain cultures and if the flow of these is a one-way flow only. Clearly, it is vital that the capacity to produce and disseminate such products and messages should be shared more fairly. It would seem that a better balance should be struck between those who produce and export cultural products and programmes and those who generally have no choice but to receive them.

The problems generated by communication in the service of man are closely linked to the rapid development of technologies for collecting, storing, reproducing and disseminating signs and images. The introduction of information technology and certain news transmission and distribution techniques, the new systems of reproduction, printing, sound and audio-visual recording and, above all, the wide dissemination of some of these techniques among the public are transforming the industrial structures of communication and affecting all those involved therein; cable and satellite transmission holds out new prospects, but also entails major changes in the respective roles of the different participants in the communication process.

This text has been extracted from "Communication in the Service of Man", Major Programme III of Unesco's Medium-Term Plan (1984-1989).



An instrument so versatile that its applications seem almost limitless, the computer is at the heart of the communications revolution. In addition to developing telecommunications facilities, computers are today used by creative artists to compose and perform music, draw pictures, make designs (like the cover of this issue, detail above) and even write poems.

The rate at which technological transformations are occurring in the communication and information field is so rapid that a continuous process of catching up has become necessary, making forward planning and decision-taking increasingly difficult, particularly in the case of countries with limited resources. While such transformations affect first and foremost the production of software and the manufacture of equipment serving to transcribe and record the messages, they have a particular bearing on the processes by which information and messages are stored, transmitted and received.

Although the race to achieve miniaturization, increased output and a reduction in cost prices may foster an increase in productivity, it nevertheless makes for an ever more rapid rate of obsolescence. The oldest means of communication, such as books and newspapers, are no longer immune to such upheavals, which may have very serious repercussions for them. The transformations affecting the various aspects and forms of communication—manufacturing methods, transmission and reception processes and techniques—can influence not only the future of the various media, but also, and more radically, that of the written and printed word. The formulation and implementation of communication and information policies matching the requirements of the different countries accordingly requires a permanent command of scientific and technological knowledge as well as of economic and industrial practices.

Foremost of the prospects opened up by the technological development and increased potential of communication is its growing role as an instrument of education and culture. With the added value conferred upon it as a medium of education, communication creates an international environment that complements if not competes with schooling, and deprives the educational system of the monopoly it has long held over education, while itself becoming a subject to be taught and studied. A reciprocal relationship is thus emerging between communication and education, one that is undoubtedly destined to develop, and that it is vital to make both positive and fruitful, particularly within the context of education conceived as a lifelong enterprise and hence based on the link between formal and non-formal schooling, and designed to provide everyone, throughout their lives, with the chance to bring their knowledge and know-how up to date and to acquire new skills.

In the same way, a growing interdependence is emerging between ▶

▶communication and culture. In modern society, the communication media are pre-eminent instruments for the dissemination of culture, but nevertheless pose serious threats to the cultural identity of many peoples. Increased access by the widest possible public to the various media of culture can be extensively fostered by the mass communication media, in particular through mass production processes and techniques. The emergence of industrial structures in the field of culture can, of course, stimulate creativity and facilitate the dissemination of culture; at the same time, however, it may give rise to serious problems and real dangers for a whole range of cultures.

The very etymology of the word "media" indicates that they are instruments for linking and, hence, for bringing men closer together. But in increasing the number of those receiving the same message, the media have often deprived individuals of certain opportunities for interpersonal communication, and have thereby even created a gulf between them. They have thus introduced an imbalance into the dialogue within societies, creating inequalities between a minority engaged in transmitting messages and the majority who are "on the receiving end". Readers, listeners and viewers are often mere passive receivers.

In many countries, machinery has been set up to secure wider participation by the public in programming and programme production, as well as in media management. This democratization of communication takes various forms, according to the circumstances. The development of decentralized media can serve to foster greater participation, in particular in the field of rural communication and rural development, and may enable underprivileged sectors of the public to receive more abundant information emanating from a wider range of sources and better suited to their particular requirements; it may at the same time offer them the chance to be not merely passive receivers, and to make their concerns and points of view known.

The media lie at the heart of various problems dealt with in Unesco (literary and artistic creation, protection of copyright and dissemination of a wide range of works). Making, as they do, extensive use of intellectual and artistic works the media provide intellectually creative people and different types of artist with enormous opportunities for work and self-expression. They stimulate creativity as well as raising the problem of the protection of authors and the dissemination of their works. In this respect, it seems desirable to find a balance between overprotection—which might be detrimental to the dissemination of works of use to a wide public—and the abuses which might, conversely, harm the artists.

Communication and information have become major economic forces of our time alike at national and international levels. Representing as they do an ever larger proportion of the gross national product of the industrialized countries, they constitute a dynamic sector that offers considerable growth prospects and hence new job opportunities. In a single major industrialized country, it has been calculated that in 1982 the communications market as a whole already amounted to 21.3 thousand million dollars, and that this market should total 103.1 thousand million dollars in 1990, that is, an increase of 490 per cent in eight years. Communication is becoming the key activity in the most highly industrialized countries, where already more than half the working population is directly or indirectly engaged in producing, processing and distributing information. Communication and information have thus become the advanced sector of the growing economy.

However, the situation is by no means the same in all countries. The huge disparities that exist at international level in the production and circulation of messages and programmes is today a recognized fact. In 1978, the developing countries, representing 70 per cent of the world's population, commanded only a small fraction of the media of

Right, as part of a Unesco project in Mali, a group of men and women who had neither used video equipment nor had even seen television before were successfully trained to make their own video programmes for use in support of the country's Women's Literacy Programme.

Photo Jay Savulich © Martha Stuart Communications, New York

World Communications Year

COMMUNICATIONS and development are inseparable. Effective communications services are vital to the rational management of economic activities in the complex world of today. Without adequate communications infrastructures the developing countries cannot hope to achieve any real measure of self-sufficiency, they will be denied access to the store of knowledge accumulated in the world's data banks, development strategies will have little chance of achieving lasting success and the grand design of establishing a new international economic order will be seriously compromised.

It was in recognition of "the fundamental importance of communications infrastructures as an essential element in the economic and social development of all countries" that, in proclaiming 1983 World Communications Year, *the General Assembly of the United Nations deliberately added the sub-title* Development of Communications Infrastructures.

The purpose of the World Communications Year is thus to increase the scope and effectiveness of communications as a force for economic, cultural and social development.

Two difficulties immediately come to mind. Firstly, the cost of establishing viable communications infrastructures appears, at first glance, to be alarmingly high given the present state of the world economy. It is vital therefore to recognize the multiplier effect of communications which have become the keystone of the economic edifice.

Secondly, the very rapid rate of advance in communications technologies and the bewilderingly wide variety of systems available, not all of which are compatible with each other, makes selection of the type of technology to be adopted extremely difficult.

Government leaders and decision-makers are thus faced with choices which are difficult to reconcile. Only through a concerted effort of planning and co-ordination at both the international and the national level will viable solutions be found.

The activities to be undertaken during World Communications Year are therefore designed to achieve the following objectives:

- *to focus attention on the need to develop national communications infrastructures in view of their primary importance in the overall development process;*
- *to ensure proper co-ordination in the establishment of these infrastructures so that all sectors of a country's economy can make a balanced, complementary contribution to its total socio-economic development;*
- *to inform planners, decision-makers and the public about the opportunities offered by the new techniques and systems available so that they will be able to make rational and informed choices;*
- *to mobilize national and international resources for the intensive development of communications infrastructures, particularly in the poorest regions;*
- *to make proposals for the elaboration of a global communications policy within the context of national and international development strategies.*

Richard E. Butler
Secretary-General of the International Telecommunications Union and Co-ordinator of the World Communications Year

Official emblem of World Communications Year, 1983.

communication: 22 per cent of book titles published, 17 per cent of total newspaper circulation, 9 per cent of newsprint consumption, 27 per cent of radio transmitters, 18 per cent of radio receivers, 5 per cent of television transmitters and 12 per cent of television receivers.

Far from diminishing, these disparities, which also affect certain industrialized countries, have on the contrary been constantly increasing as technology has developed. Disparities between rural and urban areas are also particularly marked throughout the world.

Communication and information may be regarded as the nervous system of contemporary societies; they play an essential role in economic and social development, and the present disparities in capacities for communicating and acceding to information serving to promote progress, in particular scientific and technical information, reflect the very serious inequalities existing in the world between different nations. In order to vanquish poverty, to combat illiteracy, to increase their educational potential, to master science and modern technology, and to ensure the full flowering and enrichment of their own cultures, the countries of the Third World need to increase their capacities to create, disseminate, receive, store and utilize information in ever greater quantities. ■

Doubts, fears and hopes

by Jean Ping

AS a result of the stupendous achievements of modern science and technology, instruments of communication have become so sophisticated that no part of the world is today isolated; our planet is thus neither more nor less than a "global village".

However, this great human victory is also a two-edged sword. Used constructively, it serves to transmit knowledge, fight illiteracy, encourage respect for human rights and the rights of peoples, consolidate national unity, foster international understanding, and promote economic and socio-cultural development.

But it can also be used, along quite different lines, to subjugate man, to incite to war or racism, to restrict the liberty and sovereignty of peoples, to encourage cultural alienation, and to propagate "disinformation".

A growing number of Third World countries are interested in the immense possibilities opened up by the technological explosion in communication. Whoever disposes of technology disposes of communication and thus, also, of power.

However, a small number of industrialized countries and transnational corporations possess a virtual monopoly of these high technologies (electronics, informatics, telematics, satellites, etc.). It is actually in this field that the gap between developed and developing countries is widening the most seriously, and may have the most grievous consequences.

The first of these consequences concerns the technological dependence which is exemplified notably by the "structural grip" of the North, and the transnationals' control over research and development, the sale of patents and licences, the delivery of equipment and software, the provision of spare parts and maintenance services, or the operation of artificial satellites.

The second has to do with "absorption capacity". The speed of technical progress very often exceeds the capacity of developing countries to absorb and master such highly specialized technology, which can only be of benefit to them if a minimum of conditions favourable to its assimilation already exist (specialists, qualified personnel, training and research centres). Unfortunately, certain technological choices are imposed by the transnational corporations with reference to their own interests (profits, marketing strategy, dumping) and not the real needs and local conditions of the receiving countries.

Another major consequence is that the tensions between modernity and tradition usually reveal themselves in the downgrading, the marginalization and even the disappearence of certain traditional modes of interpersonal communication; this unequal impact may even lead to ethnocide. Almost invariably the result is an impoverishment of the cultural heritage of humanity and an increase in the feeling of isolation on the part of individuals with, on the one hand, a majority of "receivers" forced into a passive role as listeners, and on the other, an active minority of "transmitters".

It is only one step from a technological grip to an economic grip, a step which it is all the easier to make since communication has become a key economic resource in international exchanges. It has been calculated, for example, that one European country will draw 85 per cent of its foreign earnings from the sale of information in one form or another (patents, licences, royalties, technical know-how, etc.)

But the situation is very different in the Third World, since the international division of labour inherited from the colonial situation has "specialized" our countries in the production and export of raw materials and the import of services and manufactured goods.

The communications industry is increasingly characterized by excessive oligolopolistic concentration and a growing transnationalization, as the Dutch specialist Cees Hamelink pointed out when he wrote that "75 per cent of the current market in communications is controlled by some 80 transnational corporations", all of them belonging to the industrialized world. This is an indication of the extent to which communication, as a major economic resource, is unequally distributed in the world.

These inequalities naturally play a part in increasing the economic dependence and accentuating the imbalances to which the developing world is subject: excessive indebtedness, chronic built-in balance of payments deficits, deteriorating terms of trade, imported inflation; in short, the development of under-development.

Thus it could not be more clearly apparent that the New International Information and Communication Order is an indispensable precondition for the establishment of a new, more just and more equitable international economic order.

There is no need to stress the increasingly close links between communication and culture. But, if it is now recognized that the mass media in contemporary societies are privileged instruments of cultural diffusion and important centres of artistic creation, it is nonetheless true that they also engender "perverse effects" which present serious threats and real dangers for the cultures of many peoples.

This is due notably to the fact that the developing countries attach too high a priority to infrastructure ("hardware") in comparison with the content of the message and everything covered by the notion of software. Once the equipment is installed, there usually ensues a veritable invasion of imported programmes which reflect foreign cultural models, with attendant risks of the erosion of endogenous values and cultural alienation.

This is the case with cinema and television through which these imported models go down into the street and contribute to the moral disintegration of traditional societies.

The same goes for the transnational cultural industries which propagate in our countries the uniformizing and homogenizing model of what Francis Balle has called a new "standardized, average, mildly euphoric culture, against a background of commonplace ideas, produced according to an industrial technique". Likewise the great organs of information which usually convey a deformed and incomplete image of the developing countries, giving prominence to the sensational and the scandalous.

This makes it possible to understand why the international community cannot be indifferent to the problem of the content of messages. What, for example, will be beamed tomorrow across national frontiers by direct satellite television? What language? What culture? What politics? Such questions fuel the anxieties, the fears, the frustrations, but also the hopes, of the developing world. ■

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Photo Unesco-J. Ader

In Madagascar, schoolchildren listen to songs recorded by children of another school far away.

Third World Voices

Extracts from speeches by delegates at the Unesco General Conference, Fourth Extraordinary Session, Paris, 1982.

The promotion of rural communication merits particular attention, to the extent that it makes it possible to offer to the widest strata of the population information to which everyone has a right, and thus encourages increased participation by the masses in socio-economic development and cultural life, the progress of education, and the application of new methods and technologies.

Rwanda

Communications between peoples and cultures with the discoveries of science and technology which enable man to cross time and space at a speed unthinkable to most of us has created and will further create new dimensions in the life of human societies. Indonesia believes that communication and information as a cultural force, which also transmit the cultural values and identity of every nation, deserve our earnest attention with a view to developing them in such a way that services and support to the overall development plans of Unesco's Member States may be provided.

Indonesia

In few areas has there been so much technological development as in communications; those who possess these media tend to use them to communicate and diffuse unilaterally their ideas and concepts of reality, while the poor countries remain in conditions of inequality, lacking mechanisms whereby they can make their voices heard and at times exposed to the process whereby their image is manufactured, with grave distortions, by others. We believe that in this field it is necessary to pursue policies based on equity and on the democratization of means of expression.

Ecuador

There is also an indispensable factor of development, at the present time, which constitutes a kind of transmission belt in each and every one of the usual activities of society: communication. It has been wisely remarked that communication is power. As a result of the coincidence and complementarity of a series of closely interrelated technologies, the world of communication has undergone rapid and accelerated change which accounts for its constant presence in most aspects of the life of societies. Of course it is obvious that the progress of communication and information in the developing countries is crucial for their economic, political and social development, and to bring this about it is indispensable to count on the solid and equitable support of the international community.

Panama

It is a fact that the new international information and communication order is dialectically linked to the new international economic order. The tenacity with which the wealthy oppose the latter thus explains, essentially, the multiplication of the barriers raised against any profound change in the field of communication. The extremely rapid development of information technologies, which remain the preserve of a tiny minority of advanced countries, may even, if care is not taken, lead to a new strengthening of monopolies and an aggravation of disequilibria. It is thus particularly opportune that Unesco should stimulate and further reflexion on questions related to data banks, for example, as provided for in the major programme on information systems and access to knowledge.

Algeria

The challenge of the chip

by Aleksandr F. Baryshev

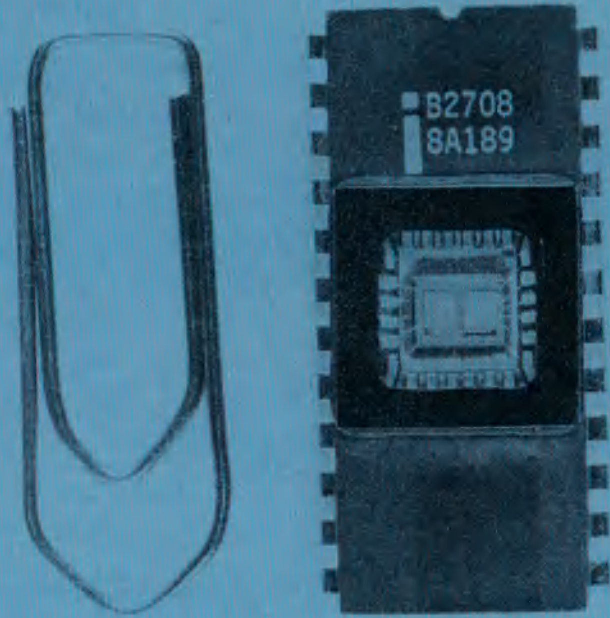


Photo Michel Claude, Unesco

With its thousands of components, this microprocessor, magnified 3.5 times in our photo, controls everything—words, pictures, graphics, colours, etc.—that appears on the screen of a modern computer terminal.

WITH electronic watches and pocket calculators at one end of the scale, and huge computer complexes at the other, it has become difficult for us to imagine a world without semi-conductor devices of one kind or another. Indeed, we might suggest that "micro-electronics" is having a "macro-impact" on the social and economic life of human beings, and in two specific domains in particular.

In the first place, working conditions and the actual distribution of jobs are undergoing profound changes as a result of the process of *automation*. This process began some thirty years ago, but although the problems involved have been discussed throughout the intervening period, it is only during the last few years that their importance and urgency have been fully recognized, with the appearance on the world market of the microprocessor—a piece of electronic equipment which, in fact as well as in theory, is capable of taking the control of entire manufacturing activities and of many service industries out of human hands. It is hard to conceive all the social and economic implications of this development.

Secondly, microprocessors have proved to be by far the most efficient instruments—from the technological and economic points of view alike—for handling the vast and rapidly increasing flow of *information,* whose role in the affairs of the modern world cannot be overestimated.

Before going further, let us recall the basic characteristics of the microprocessor itself, the most precocious child of semiconductor technology, whose own rapid development has made it possible to implant what are known as integrated circuits on tiny (no greater than 5 × 5 mm) slices of silicon, called "chips". Depending on the density of the circuits, this process is known as large-scale or very large-scale integration (LSI and VLSI). At first, these systems were used for memorizing operations, and for certain logical operations. Later, and as a result of the increased sophistication of the integrated circuits, it became possible to place on a single silicon chip the means of carrying out logical, memorizing and input/output functions, and of relating these functions to each other.

This breakthrough led to the creation, in 1971, of the first microprocessor, a piece of equipment which carries out the functions of one of the basic components of a conventional computer—the central

ALEKSANDR FEDOROVICH BARYSHEV *is a Soviet specialist in the application of computer technology to control systems. A member of the International Research Institute of Control Sciences, he is the author of a series of studies concerning automation, a field in which he has also been responsible for a number of innovations.*

processing unit, or CPU. In other words, the microprocessor is capable of deciphering and executing the instructions contained in a programme (which, in a computer, is committed to its memory, the second basic component), and of controlling the process of acceptance and supply of information (the input/output component of a computer). Infinitely smaller than a conventional computer, and consuming far less power, the microprocessor, when it is connected to appropriate external elements, actually becomes a "microcomputer".

The development of microprocessors and microcomputers alike is taking place at great speed. If the past 30 years have seen the appearance of only four successive generations of computers, a fourth-generation microprocessor made its appearance only eight years after the first. This means to say that, at the present rate of progress, a new generation is emerging every two years, to become obsolete after a period of three or four years.

Microprocessors and microcomputers are playing a significant role in the development of many different branches of industry. According to the Soviet scientist, Academician Gury I. Marchuk, microelectronic technology will, in the forseeable future, have been applied in more than 200,000 different devices and systems in industry and in the home. This is indeed a technological revolution!

Specialists reckon that some 250 million units and systems incorporating microprocessors were in use throughout the world at the end of 1980, and that between five and ten thousand million will be in service in the year 2000.

They are being more and more widely used in many fields, notably in medicine. Microprocessors enable sophisticated methods of calculation to be perfected, to make more accurate diagnoses of illnesses of the cardiovascular system and brain illnesses, through such processes as electrocardiography and tomography, and to check the patient's psychophysiological characteristics. They are also used for the continuous supervision of patients during the post-operatory period, and in the application of intensive therapy. In this way they make it possible to take the necessary measures and considerably facilitate the work of the medical staff.

Microprocessors also play an important role in the production of consumer goods, cars, games and toys, apparatus in everyday use, household computers, etc. The number of machines of this kind, which stood at 80 million in 1980, could reach 200 million in 1984. The application of microprocessors and microcomputers is developing above all in the leisure industry and in the automobile industry.

The promise of the microprocessor lies in the manner in which it combines low cost, size and power consumption with high information-handling capacity and reliability. Thus, for example the first microprocessor, "Intel-8008", cost $360, whereas an improved version, which appeared two years later, cost less than $30. Today far more sophisticated microprocessors such as "Intel 8080" and "Zilog 80" cost between 4 and 5 dollars and this trend towards reduced costs is continuing.

The format of today's pocket calculators is determined by the size of the keyboard, and not by the printed circuits they contain. Indeed, the information-handling capacity of such circuits is steadily increasing. Between 1975 and 1978, the packing density of a silicon chip measuring 1 mm^2 grew in a ratio of 1:80,000. If this trend is maintained, a single chip may well be carrying up to 10^9 electronic elements by the mid-1990s, although this will depend on the solution of a great number of outstanding problems. In recent years, the reliability of microprocessor circuits has increased three to four times.

The appearance of microprocessors and microcomputers forms part of the phenomenon which, in many circles, is called the "information revolution", defined by the Canadian scientist T.R. Ide as a combination of developments in telecommunications on the one hand, and in computer technology on the other.

In essence, the computer is an "information machine". Information arrives from the external environment via its input mechanism; the machine stores this information, processes it according to a predetermined set of rules, and then produces the results via its output system. In other words, the computer establishes a relation between different facts, evaluates analogies, and carries out other functions; it interacts with, and helps to change, its environment, thereby revealing itself capable of replacing human intervention in many intellectual processes.

At this point, we might pause to consider the biological aspects of the development of information. The Swiss scientist, B. Fritsch, has suggested that the first great quantitative jump forward in this process occurred during the Stone Age, when men began to assimilate a greater amount of information directly from their immediate surroundings (than as a result of transmission from generation to generation). The second jump took place some 5,000 years ago, with the invention of different forms of writing, which made it possible to store information elsewhere than in the human brain; the invention of printing was merely a qualitative refinement of this breakthrough.

The creation of microprocessors may be seen as the third spectacular jump as far as the development of information is concerned. Again for the first time in history, it has become possible to store not only information, but also intellect.

When we bear in mind that the first of the above three stages covered a period of a hundred million years, the second several millennia and the third only a matter of decades, we realize that the entire process of information development is accelerating at an almost unbelievable rate.

The "information" content of automation is becoming increasingly ▶

Recent improvement in radio telephony has been a major life-saving factor, enabling doctors and nurses to intervene during the crucial early period after a serious accident, a heart attack or other emergency. Left, all the emergency vehicles of the ambulance service of the Lithuanian SSR are equipped with modern ultra-short wave radio telephones.

Photo WHO, Geneva

apparent. In fact, automation is only an efficient process when it is backed by an economic and well-organized capacity to collect, conserve, analyse and transmit information. All control systems function on the basis of information-handling in the sequence: input—processing—output; the role of microprocessors in such systems is to furnish the capacity to process information inputs and to devise control operations.

At the beginning of the 1960s, the famous Soviet mathematician, Academician Victor M. Glukhov, drew attention to the need to introduce automation into control procedures. Under his direction, the first project was drawn up for a network of State computing centres which would be established to reorganize, without using paper as a medium, the mechanisms of administrative and economic management, from plant to "Gosplan" level.

Later, from 1965 to 1970, the Soviet Union carried out a programme of automatized management at plant level and in various ministries. The experience thus acquired made it possible to define the task of computing centres in the State network: they would constitute the technical basis of a global automatized system for collecting and processing management and planning information. This is an ambitious programme which is taking more than a decade.

But what of the information itself? The current rate of growth of scientific and technical information is estimated at 12.5 per cent per year. In other words, we are faced with a paradoxical situation in which men are called upon to exercise tighter and tighter management over the economy, and where the number of decisions they must take, based on factual information, is increasing exponentially from year to year.

It is in this context that microprocessors and other types of microelectronic equipment come into their own, as the basis for highly cost-effective information systems. For example, the total amount of information required to enable a university student to complete his education may be expressed in 3.1×10^7 words, incorporating 1.64×10^8 signs; modern electronics makes it possible to store all this information in no more than the volume of space occupied by a packet of cigarettes.

Improved accessibility of information is not only changing the face of education. The application of microelectronics is transforming the pattern of job distribution not only within individual enterprises, but in entire branches of the manufacturing and service industries. The proportion of research and development (R & D) personnel in factories producing office and management equipment has, for example, increased significantly in recent years. According to the Italian scientist Bruno Lamborghini, the proportion of the employees of one large Italian company engaged in research rose from 5.6 per cent in 1970 to 9 per cent in 1978; during the same period, the proportion of production workers fell from 45 per cent to 31 per cent.

Similar trends have been observed in a number of Western European countries. These changes call for a radical modification of educational systems. Rapid growth in the application of microelectronics, the rate of renewal of techniques and technologies and the increasing output of microelectronic products are leading to a situation where it is essential to relocate large numbers of workers, and to train them for new tasks.

In many fields of human activity, a thorough renewal of knowledge and skills is already required every five or six years, and it is possible that this period will be considerably reduced in the future. Conditions are thus ripe for lifelong education—a concept which Unesco has consistently advocated—and, in the opinion of some specialists, for the incorporation of basic instruction in information processing and microelectronic technology in general education programmes.

It is not surprising, therefore, that many scientists and specialists throughout the world believe that the solution of the problems posed by the widespread application of microelectronics is closely related to the issues of education, science and culture. This view was clearly advanced, for example, during the *First European Conference on the Socio-Economic Problems and Potential of the Application of Microelectronics in the World of Work,* held in the Netherlands in September 1979 and at the meeting of the Club of Rome, in Austria, in February 1982.

Microelectronics opens up qualitatively new possibilities for individual development; but at the same time it makes increased demands as far as the numbers and skills of scientific and technical personnel are concerned. The compulsory secondary education provided in the Socialist countries lays the necessary foundation for proceeding to a technical and university education, and thus seriously addresses the problem of creating a completely new type of worker—one who has received higher, specialized education.

In the Socialist countries, the changes brought about by microelectronics in the world of work have a generally positive character, although the possibility that they may exercise a negative influence on certain groups of workers or on certain situations cannot be excluded. But, under conditions of full employment, these negative aspects can be countered by the reorientation and re-education of the workers concerned, so that they may apply their energies and knowledge more effectively in other fields of productive activity.

Study of the social and economic consequences of the spread of these new technologies forms part of a co-operative programme adopted by the Council for Mutual Economic Assistance (Comecon), in July 1982, with a view to promoting the development of microprocessors and their application in member countries over a period extending up to 1990. The programme lays emphasis on the training and recycling of intermediate and high-level technicians in this field.

According to figures from the US Bureau of Labor Statistics, automation may, by the end of this century, lead to a situation where no more than 10 per cent of the country's workforce are employed in manufacturing industry. At present, in a number of non-Socialist industrialized countries, the figure ranges between 35 and 50 per cent.

The introduction of microelectronics poses special problems in the developing countries. In so far as the development of the appropriate technology demands an impressive amount of initial capital investment, as well as a firmly established scientific and technical infrastructure, it is particularly difficult for these countries to carry out their own R & D activities in the fields of computers and telecommunications.

Furthermore, the development of information systems on an international basis has political, as well as economic implications for the developing countries. Their governments cannot obtain control over information emanating from locally-implanted manufacturing or service industries, because the archives and data banks in which this information is stored are concentrated, as a rule, in the hands of transnational corporations, which thereby retain control over the information itself.

The economic implications of the problem lie in the fact that information tends to flow towards centres where it can be most effectively and economically processed, which means, once again, in the direction of the transnational corporations.

As we said at the beginning of this article, it is still difficult to present a comprehensive picture of all the social, economic, organizational, scientific and technical problems posed by the ever-widening application of microelectronics and by the growth of microelectronic information-handling capacities. Nevertheless, it is certainly not too early to consider, with every justification for doing so, that the development of the microprocessor may well go down in history as the world's fourth industrial revolution.

■ **Aleksandr F. Baryshev**

Photo B. Oumaikin © APN, Moscow

The robot workshop of the machine-tool factory at Krasnodar, on the Kuban River, one of the principal robot producers of the Soviet Union.

Anatomy of the computer

FIVE hundred years ago, in Renaissance Europe, culture was disseminated by the newly-born printing press. At the heart of the modern revolution in communications technology is the microcomputer.

WHAT IS A COMPUTER ? A computer is a tool. A tool operates by taking **raw material** and converting it into a **product.** It is a **device** which performs a **process.** The process is determined by **people.**

The computer's raw material consists of **facts** or **data.** The product that it generates from this raw material is **information.** The **device** is an array of electronic and mechanical gadgetry which is known as **hardware.** A computer is entirely dependent on instructions supplied to it by its **human users.** These instructions, or **programs,** which tell the computer how to carry out specific **processes** or tasks are known as **software.**

WHAT COMPUTERS DO is to perform prodigious feats of arithmetic, handling millions of numbers per second. They achieve these dazzling exploits not because of any superhuman powers of intelligence but because they can carry out a few extremely simple operations accurately and very fast.

HOW DO THEY DO THIS ? The inside of a computer is a complex maze of **on-off switches** which are used to perform the computing activities and can also store information in the computer's **memory.** Because they are assemblies of switches, computers work by using the **binary system of numbers.** In the binary system any number can be described by the values 1 or 0, which can be represented by turning a switch **on** (to mean 1) and **off** (to mean 0). All information in the machine is thus reduced to two expressions, which can be variously defined as zero (0) and one (1), off and on, or no and yes, corresponding to the presence or absence of an electrical charge at a particular point. Early computers relied on electromechanical on-off switches called relays which physically opened and closed. Today hundreds of thousands of them can be etched on to a minuscule fragment of silicon—the **microchip.** The heart of the machine is a **central processor,** a special chip on which instructions are stored and obeyed.

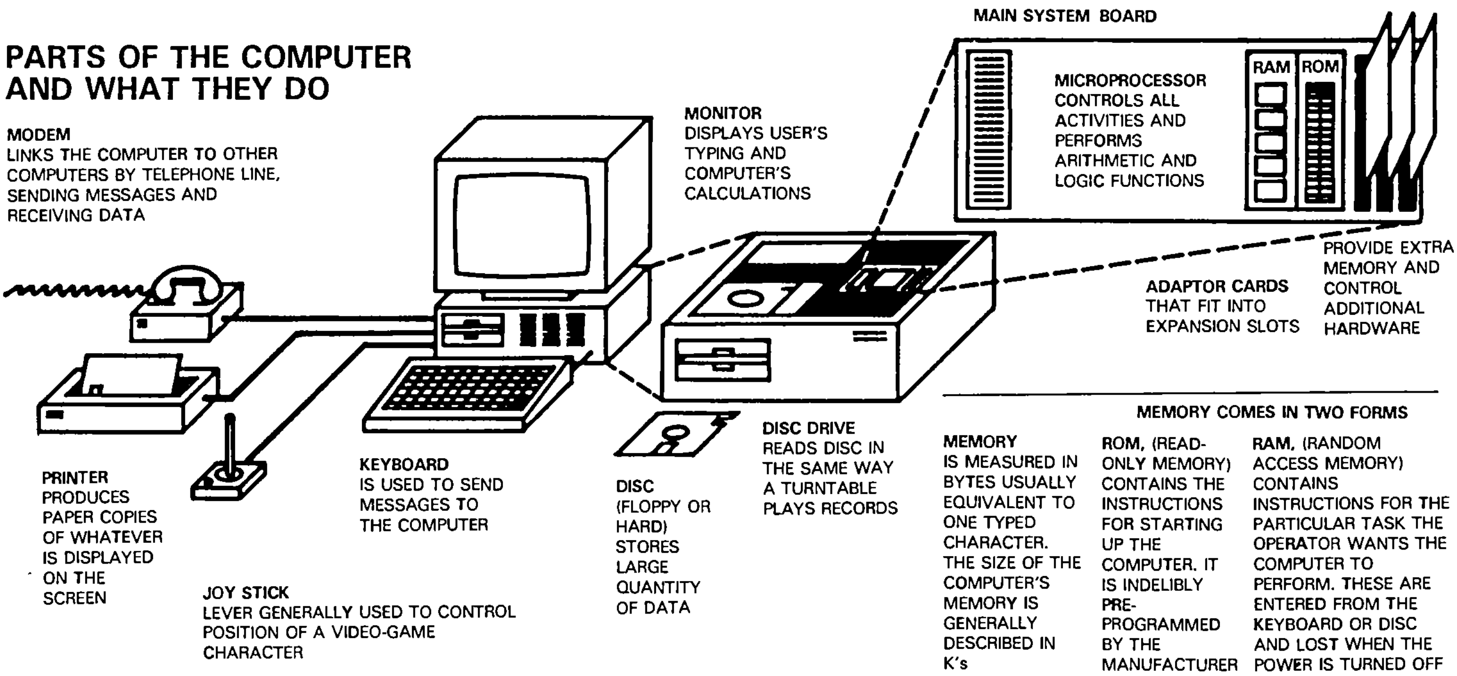
Unlike the decimal system which uses ten digits (0 to 9), the **binary system** uses only two digits, 0 and 1, which can be used to describe any number. To create a 2, you simply move 1 a column to the left, just as you do to create a 10 in the decimal system. Thus if zero is represented by 0 and one by 1, then two is represented by 10, three by 11, four by 100, five by 101, and so on. Thus the computer solves complex problems by breaking them down into long strings of 0s and 1s. (Because the computer performs its calculations using binary numbers, computer scientists coined the word **bit,** from Binary digIT, to describe the smallest piece of information it can handle).

DECIMAL	BINARY EQUIVALENT
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111
16	10000

A computer can read a book to a blind man, speaking aloud in its own artificial voice. Advances in computer speech recognition may soon eliminate the need for a manually operated keyboard. Control mechanisms exist that can be operated with just a toe. But perhaps the greatest benefit the computer offers to handicapped people is that it can give them access, in their own homes, to a wide range of information, entertainment and job possibilities from which their immobility previously shut them out.

Photo Alberto Mayal, Unesco

PARTS OF THE COMPUTER AND WHAT THEY DO



MEMORY COMES IN TWO FORMS

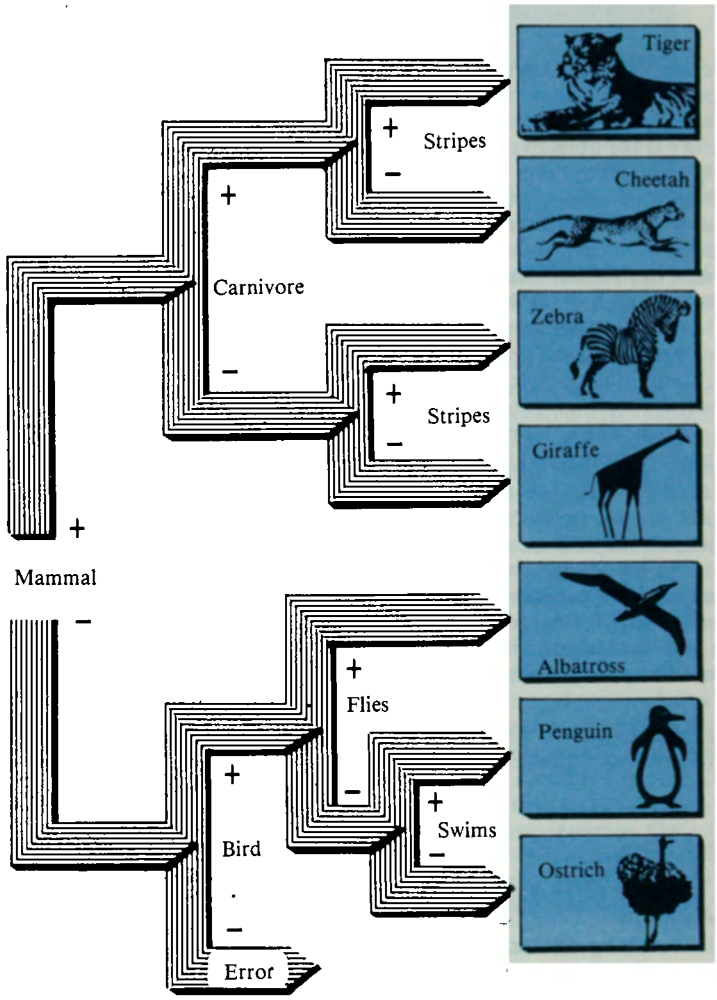
MEMORY IS MEASURED IN BYTES USUALLY EQUIVALENT TO ONE TYPED CHARACTER. THE SIZE OF THE COMPUTER'S MEMORY IS GENERALLY DESCRIBED IN K's (IK = 1,024 BYTES)	**ROM,** (READ-ONLY MEMORY) CONTAINS THE INSTRUCTIONS FOR STARTING UP THE COMPUTER. IT IS INDELIBLY PRE-PROGRAMMED BY THE MANUFACTURER	**RAM,** (RANDOM ACCESS MEMORY) CONTAINS INSTRUCTIONS FOR THE PARTICULAR TASK THE OPERATOR WANTS THE COMPUTER TO PERFORM. THESE ARE ENTERED FROM THE KEYBOARD OR DISC AND LOST WHEN THE POWER IS TURNED OFF

Programming means giving instructions to a computer before it begins work on what it must do and how the work must be done. Instructions are fed into the computer by various methods such as a typewriter-style **keyboard** which, instead of typing letters, sends electrical impulses into the system. They are "written" in one of the "languages" which computer scientists have devised to translate human wishes into some variation of the computer's two-word vocabulary, explained above. A program thus really involves setting up a number of switches to go on and off to order.

The **control unit** in the machine's **central processor** acts on the instructions given by the user to fetch information from the computer's memory. This information is used by an **arithmetic and logic unit,** which also forms part of the central processor, for the required computing operations.

Answers to problems can be presented in various ways; they may be **printed** or displayed on a **visual display unit,** which is like a TV screen.

In addition to ordinary alphabetic or numeric characters, the computer can have special **graphics,** characters for creating diagrams on the screen. Detailed pictures can be created by turning on and off hundreds of thousands of separate dots on the screen. This is how the figure of Rodin's *Thinker* on our cover was produced. ■



How a computer thinks

A decision tree is one way in which a computer can be made to "think". The tree is an ordered set of rules that leads the computer to reach a conclusion. This simple diagram shows how a computer would use the decision tree to identify one animal from among a number of possibilities. First the computer determines whether the animal is a mammal. This example assumes that the computer can answer that question either by carrying on a dialogue with a person at a terminal, or by being able to analyse various pictures of animals with a camera eye. If the animal is a mammal, the computer decides if the mammal is a carnivore. If it is a carnivore, the machine looks for stripes to choose between a tiger and a cheetah.

The office of the future
Photo Greg Davis © Sygma, Paris. Taken from an album of photographs on *Communication*, compiled by the Unesco Photographic Unit, to be published shortly by Unesco.

Japan hooks up for the 21st century

THE establishment of a nationwide, error free, high-speed information network during the early years of the 21st century is the objective of the Nippon Telegraph and Telephone Public Corporation (NTT) of Japan. In a paper presented at a symposium organized by IDATE (*Institut pour le Développement et l'Aménagement des Télécommunications et de l'Economie*) and held at Montpellier, France, in October 1982, Masatoshi Murata of the commercial bureau of the NTT described this ambitious project which will make full use of recent advances in digital telephone, optical fibre, computer and satellite communication technology.

The basic technology for this revolutionary Information Network System, as it is to be called, already exists, although its integration into a homogeneous system will raise complex technical problems. But what advantages does it offer to ordinary men and women and what effect will it have on their personal lives and on the society in which they live ?

Masatoshi Murata painted the following picture of life with the system:

In the home

- Daughter holds a three-way telephone conversation with two of her friends.
- Mother makes a long-distance call while keeping an eye on the displayed call charge.
- Father sends invitations to a dinner party using the facsimile service.
- Son scans a list of part-time jobs available.
- Daughter plays a computer game.
- Father consults the bus time-table.
- Mother consults the price list of her local store and places an order.

In the department store

- Salesgirls compile and send out price lists and details of special offers and receive orders from home terminals.

At school

- A teacher sends a list of questions to students at home and receives answers from them.

At the local government office

- A clerk despatches facsimile copies of driving licences and other documents directly to applicants' homes.
- A public relations officer sends a publication simultaneously to a number of community leaders.
- Documents are passed by facsimile between the headquarters and branch offices.
- Discussions in the municipal assembly are telecast to television receivers in community centres.
- Lectures and discussions are held in a community centre and are telecast to television receivers in other community centres.


Photo Jason Laure © Cosmos, Paris

• Municipal government information, including lists of government-sponsored meetings, welfare services, application procedures, etc., is instantly available to the public.

At the office

• A comprehensive office work station is installed beside the manager's desk. It incorporates a facsimile machine and a word processor to enable him to send or receive various forms of documents instantaneously. It can also be used as a data storage terminal to gain access to the management control and inventory control system.

• Video teleconference calls are used as a substitute for physical travel.

• Terminals are used to give computer-assisted education to employees.

• Some employees work at home rather than at their office.

• Offices are relocated to rural areas and are connected to headquarters via communications lines.

This by no means exhaustive list of the possibilities the system offers (the possible uses of the system for banking procedures, for example, are immense) gives some idea of the social transformation that introduction of the system would involve.

Some of the advantages of the system can be seen immediately. More workers could work at home or at small offices near their homes equipped with office automation terminals, thus avoiding the daily misery of commuting. Much of the drudgery of work would be eliminated, leaving more time for really creative employment. A whole new world would be opened up for physically handicapped people and those who, for one reason or another, are housebound. All citizens would be better informed about, and thus be able to take fuller advantage of, local events, government services and locally-available leisure-time activities.

There might, however, also be a number of adverse effects. A society that became over-dependent on such a closely-knit, all-pervasive system might be very vulnerable to technical failure; with a great number of terminals linked to an integrated system personal privacy and corporate security might be put at risk; over-centralization of information might result in over-centralization of power; and, finally, if home terminals were not sufficiently "user friendly", some sections of the population might, paradoxically, find even greater difficulty in obtaining access to information.

The NTT is well aware of these dangers. A model system is to be put into operation towards the end of 1984 which will serve some 10,000 subscribers in the Musashino and Mitaka area, a suburb west of Tokyo. It will also accommodate a limited number of subscribers in the Tokyo metropolitan area who will thus be able to communicate with the inhabitants of Musashino and Mitaka. The model system will serve not only to test the technical feasibility of each element of the network and to verify construction and maintenance techniques, but also to provide a first hand guide to the overall impact of the system on individuals and on society as a whole. ■

Communicating with glass and light

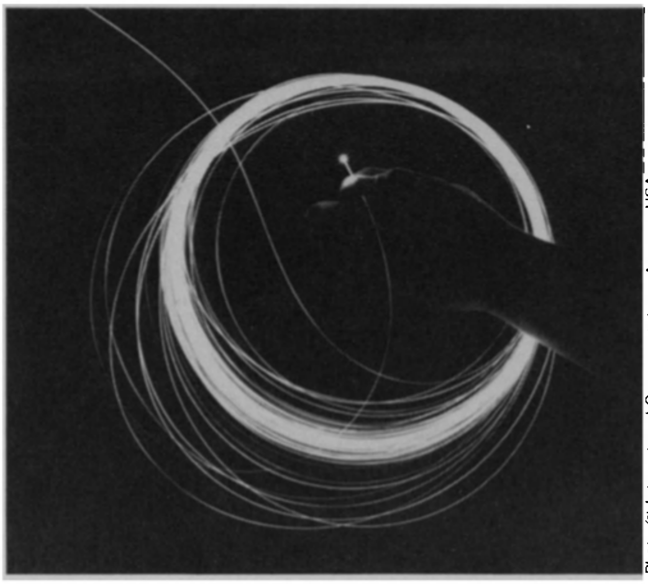


Photo © International Communications Agency, USA

OPTICAL fibres, hair-thin strands of pure glass carrying information as pulses of light, have been described as "probably the biggest breakthrough in telecommunications since the invention of the telephone". All kinds of communications can be carried along the same optical fibre cable—speech, text, photos, drawings, music, computer data, etc.—at higher speeds than have been previously possible.

The fibres, made from glass so pure that a block of it 20 km thick would theoretically be as transparent as a window pane, have many advantages over metal wires. Small, light and easy to handle, they are made from an abundant raw material, sand. They can carry the same number of telephone calls as metal cables ten times as thick—dozens of fibres, carrying around 100,000 telephone calls, could all pass through the eye of a needle at the same time—and they are immune to electrical interference which affects the quality of calls. An optical fibre cable the thickness of a finger could bring a hundred TV channels to a receiver.

The tiny strands are playing a key role in the digital revolution which is sweeping through modern telecommunications. The telecommunications network developed for the telephone used a system which turned the air pressure waves created by speech into continuous and variable "analogues" of electrical waves and turned them back to speech at the receiver. Expensive conversion equipment or separate networks were needed to handle text, TV or computer data. In the digital world, however, all forms of information are translated into *bits*, the standard internal language of today's computers (see page 14), and represented as pulses of light. Information in this form can be processed easily and sent anywhere in seconds in a single multi-purpose network. Optical fibres are ideal for digital working and open the door to a host of services not possible on an analogue system.

Each strand of fibre consists of an inner core to channel the light and an outer cladding to keep it in by reflecting it back along the core. To make the glass for the fibres, the ingredients are deposited as gases on the inside of a hollow silica tube at temperatures of around 2000°C. The tube is collapsed under intense heat to form a solid glass rod about 1 cm in diameter which already has the structure of the fibre which will be drawn from it. The rod is then loaded into a furnace, drawn into fibre and coated with a resin to protect it and increase its flexibility. Tiny crystals the size of a grain of salt are used to produce the light which carries information along the fibres. This passes through a lens into the fibre. At the other end a receiver reverses the process and turns each light pulse into an electrical signal. Optical fibres will have countless applications in tomorrow's "information society". ■

Computers and literacy in traditional languages

by Robert W. Lawler in collaboration with Mamadou Niang and Moussa Gning

As computers become increasingly common and less expensive in the industrialized nations, many more countries are entering the computer revolution. This is a time of decision for a major issue: will uniformity or pluralism be served by the technology of intelligent machines?

Computing machines are a malleable technology. Will that technology be shaped to serve different human values with reason and sensitivity? Will it be adapted so that it can be assimilated by the various, different cultures of the world? Or will we see intelligent machines applied without the guidance of human values? Will the technology be "transferred" from the industrialized nations with more haste than understanding?

If one favours pluralism more than uniformity, it is important to ask how the promise of the computer revolution can be shaped to fit various cultures in a fashion congenial to the uniqueness of each. The transfer of ideas is more important than the transfer of machines. We explore the adaptation of a computer application idea by describing in detail work I did with my daughter in the United States and how colleagues from Senegal are trying to make use of it.

MICROCOMPUTERS are pouring into homes and schools in the industrialized countries and will soon be flooding the world. It is hardly too soon to wonder what effects computers are likely to have on our children. Will computers change the way children learn? Will computers change the sorts of people children become? I believe the answers may well be yes, and although it is too early for conclusive proof, I can offer here a story that supports my belief.

I have worked in the computer industry for sixteen years, and when my children were born I became interested in the potential impact of early computer experiences on children's learning. Several years ago, in collaboration with a computer language project at the Massachusetts Institute of Technology, I began an intensive study of how daily access to a computer influenced the way my two older children—then aged six and eight—learned the basics of arithmetic. By the time their younger sister Peggy turned three, a microcomputer had become standard equipment in our household, and I began to develop several programs to give Peggy access to the machine. Playing with these programs in her own way and on her own initiative over the following months, Peggy began to do something that looks very much like the beginnings of reading and writing.

What is it really like to bring a microcomputer in your home and let your three-year-old play with it? The answer depends on who you are, your knowledge and values. The computer entered my home and my family life because it is a part of my work. It was my pleasure to write some simple programs for my daughter's entertainment and edification. My interests in children and computers led me to gather a great deal of information about what Peggy knew before her first encounter with the computer and afterwards. Between her ages of three years three months and three years ten months, Peggy began to read and write. The following sketch of how this happened is based on my own observation of only one child's learning; it is fair to say, however, that I have an enormous amount of detailed information about what this particular child knew and how that knowledge

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This article draws widely on material previously published in the Boston Review.

Photos © Robert Lawler, Paris

Peggy adding a truck.

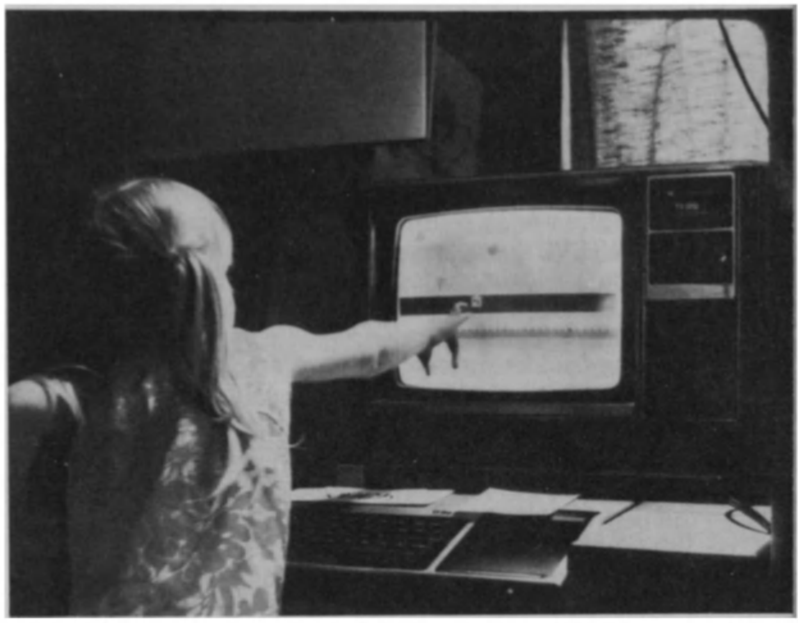
changed over a long period of time. I believe this sketch will be of general interest because Peggy's story provides some advance information about how computer experience may affect our children.

In the USA children typically learn to read around the age of six. Most learn to read at school. A few teach themselves to read earlier. Peggy, at the age of three, even living in a bookish family, did not know how to read in any substantial sense before her computer experience. Her knowledge of letters at three years, three months was quite specific and limited. She recognized only a few letters as distinct symbols with any meaning. For example, she knew that "P" was the first letter of her name. She also recognized "G" as the "mummy letter" because her mother's name is Gretchen.

What was Peggy's knowledge of spelling like? One incident gave me some inkling. My oldest daughter was learning a bit of French: one day Peggy claimed that she knew how to "spell French" and continued, "un, deux, trois, quatre, cinq." At another time her spelling of "French" was "woof boogle jig." Peggy saw the process of spelling as decomposing a meaningful word into a string of essentially meaningless symbols and had not yet learned any of the standard spellings of words.

Peggy adding a house.

Peggy's ability and willingness to identify a string of symbols as a particular word came from a very specific beginning. After receiving a gift book from her older sister (who then wrote Peggy Lawler on the flyleaf), Peggy interpreted all small clusters of alphabetic symbols as "Peggy Lawler." At a later point in time, as a consequence of being often read to, she became able to recognize a single, two letter word, "by", which appeared on the title page of every book we read to her. There is no reason to believe she had any idea of what "by" might mean in that context. Her knowledge of reading as a process for interpreting graphic material is best seen in her common observation that she read Pictures and I read Words. From her remark, we can infer she would "read" by inventing a story based on her best speculation about the pictures' meaning. She assumed that I was doing the same with words. Not a bad assumption, but completely empty of any information about how written words signify as they do.



"There it is."

Contrast now her knowledge seven months later. Her knowledge of letters is essentially complete, in that she discriminates the 26 letters of the alphabet and can name them. Her knowledge of words, in the sense of interpreting them one at a time, is significantly greater. She reads more than 20 words, most with complete dependability. But unlike children who have learned to read and write by conventional means, she sees the spelling of words as stepwise directions for keying a name into the computer. Although her general idea of what book reading is may not have changed, she has a different and powerful idea of what reading single words means that derives directly from her experience with my computer programs. Peggy's introduction to computers did not relate directly to "reading" in terms of content, but her desire to control the machine led her into keying on the computer her first "written" word. Having helped load programs by pushing buttons on a cassette tape recorder, one day on her own Peggy typed "LO" on the terminal then came seeking direction as to what letter came next. A few days later, she typed the "load" command while the rest of the family was busy elsewhere.

I call the computer environments created by the programs I have written "microworlds", following the terminology used by Seymour Papert, the man chiefly responsible for the development of the "LOGO" computer language, in his book *Mindstorms**. The initial microworlds were one for moving coloured blocks around on the video display screen and another (made for her older sister but taken over by Peggy) which created designs by moving a coloured cursor. While her sister used this drawing program to make designs, Peggy's first drawing was a large box—which she immediately converted into a letter "P" by adding the stem. Letters intrigued Peggy. They were a source of power she didn't understand. ▶

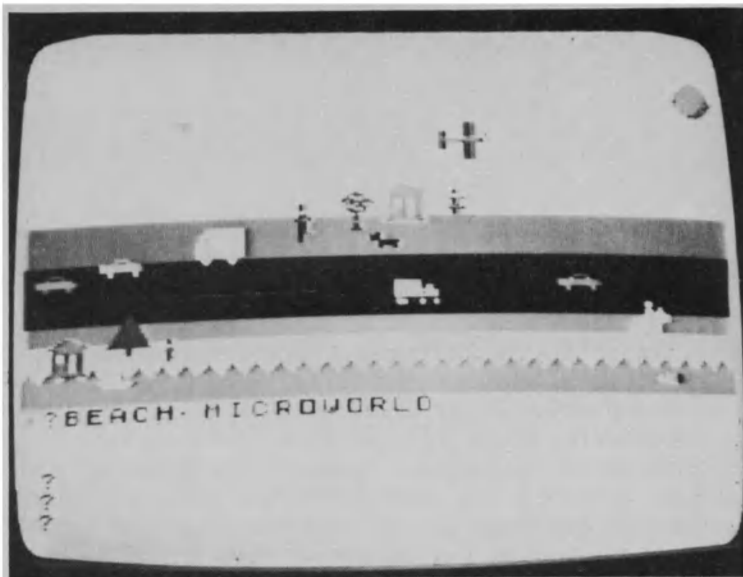
* *Mindstorms : Children, Computers and Powerful Ideas,* by Seymour Papert. Basic Books, New York, 1980.

A few days later, Peggy keyed the letter "A" and explained to me that "A is for apple." Her comment suggested a way we could—on the computer—make a new kind of pre-readers' ABC book. A child's book of ABC's typically offers a collection of engaging pictures displayed in alphabetic order with a large, printed letter associated with each picture. The child looks at the pictures and is informed "A is for apple." The relationship of letters to pictures is exactly the opposite in the ABC microworld. The letter is the "key" for accessing the picture. That is, keying the letter "D" produces a picture of a dog. Instead of responding to a statement such as "See the doggie. D is for dog," Peggy was able to try any letter on the keyboard, first, to see what it got her, and later, if the picture interested her, to inquire what was the letter's name. She was in control of her own learning. She could learn WHAT she wanted, WHEN she wanted to, and could ask for advice or information when SHE decided she WANTED it. The ABC microworld was tailor-made for Peggy. The shapes were selected and created on the computer by Peggy's older sister and brother, aged ten and twelve. As a consequence of playing with the ABC microworld—and with another to which we now turn—Peggy developed a stable and congenial familiarity with the letters of the alphabet.

More complex and interesting than the ABC microworld, the BEACH microworld provides a backdrop for action. Waves and a beach in the foreground, with grass above, rise to a road, more grass, and clouds at the top. Against that backdrop, Peggy could create a small picture of an object by specifying a procedure name, then manipulate the picture with commanding procedures. Peggy typically began constructing a scene with the word SUN. A yellow circle would appear in the waves. She would raise it to the sky by keying the word UP repeatedly, change its colour or set it in motion with another word, and go on to other objects. She could, for example, make a CAR image appear by keying that word, change its location with commands UP, DOWN, MOVE, and specify its heading and velocity with TURN, SLOW, FAST, FASTER, and HALT.

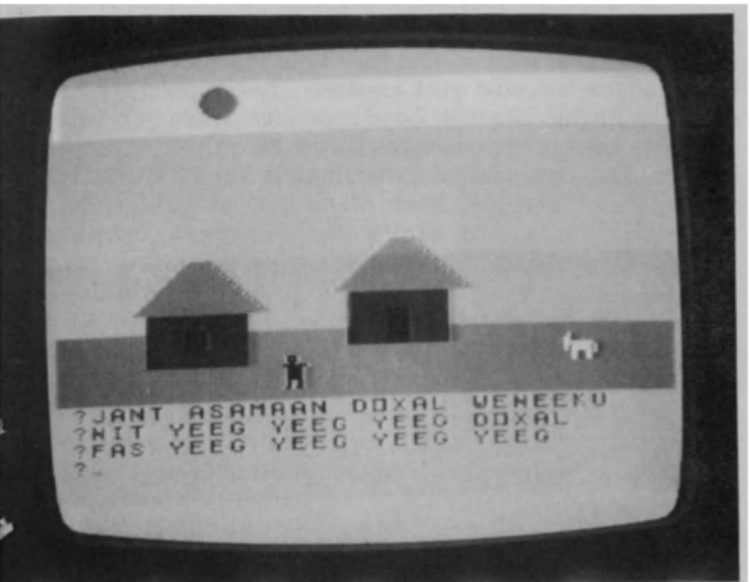
These microworlds were created using Logo, an easily comprehensible computer language which permits you to assign meaning to any string of letters by writing simple procedures. Logo's procedure definition was especially valuable in customizing the BEACH world. When Peggy first used BEACH, she was unhappy with the speed of the objects and asked, "How can I make them zoom, Daddy?" Nothing was easier than to create a new Logo word, ZOOM, which set the velocity of the object with a single primitive command. In a further instance, Peggy's older sister made a horse-and-rider design and wrote a PONY procedure to create an object with a horse-and-rider design and set it in motion. After watching her sister edit that shape design, Peggy imitated the specific commands to create her own new shape. (She could not well control the design and ended with a collection of perpendicular lines. Asked what it was, she first replied "A pony," then later, "Something important.") It is very likely that primary grade children could create their own designs and would copy and alter procedures to expand or personalize the vocabulary of BEACH-like microworlds.

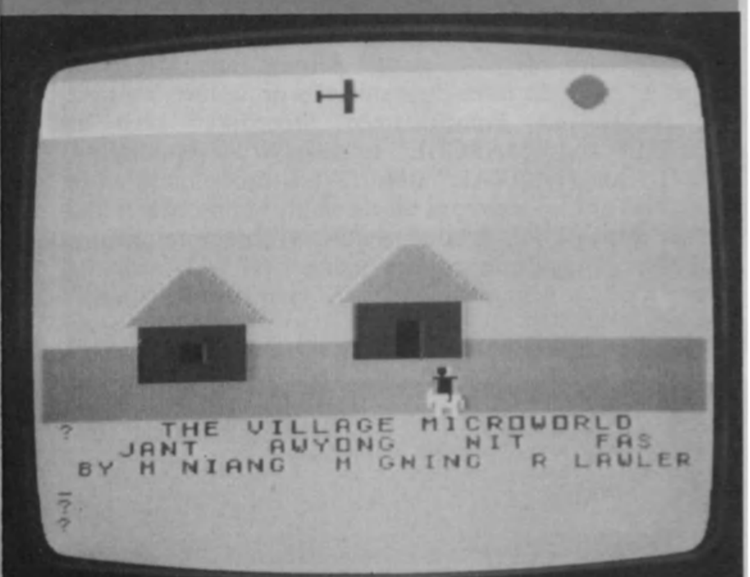
As a direct consequence of playing with the BEACH world, Peggy learned to "read" approximately twenty words. Initially, she keyed names and commands, copying them letter by letter from a set of cards. Soon, her favourite words were keyed from memory. Less familiar words she could locate by searching through the pile of cards. When her mood was exploratory, she would try unfamiliar words if she encountered them by chance. Now, when shown those words—on the original cards or printed otherwheres—she recognizes the pattern of letters and associates it with the appropriate vocal expression. Further, the words are meaningful to her. She knows what they represent, either objects or actions.



Computer microworlds

Above, the "beach microworld" created by Robert Lawler for his daughter Peggy and (right) the "village microworld" created by Mamadou Niang, Moussa Gning and Robert Lawler for the pupils of the Experimental School of the *Ecole Normale Supérieure*, Dakar, Senegal (bottom right). The microworlds are computer environments which children quickly learn to manipulate and to which they can add images of their own creation. Computers are adaptable tools, but it is vital that the software devised for them be shaped to take into account differing human values and needs. In the particular case of the Senegalese village microworld the software has been adapted to embrace Wolof, one of the traditional languages of Senegal. The meanings of the Wolof words that appear in the photos are: *jant* = sun; *fas* = horse; *doxal* = walk or go; *awyong* = aeroplane; *nit* = person; *asamaan* = in the sky; *weneeku* = turn; and, *yeeg* = up.





In the past, words for reading have always been an alphabetic symbol for an idea to be evoked in the mind. For Peggy, words are that but something else as well—a set of directions for specifying how to key a computer command. What is strikingly different in this new word-concept, as contrasted with quasi-phonetic decoding, is that the child and computer together decode a letter string from a printed word to a procedure which the computer executes and whose significance the child can appreciate. Finally, because the computer can interpret specific words the child does not yet know, she can learn from the computer through her self-directed explorations and experiments.

The basic lesson I draw from this story is NOT merely about "motivation"—although Peggy did enjoy playing with these microworlds and learned from doing so. There is a more revolutionary aspect, one paradoxical as well. This new technology can make possible a more "natural" absorption of knowledge. The character of words experienced as executable procedure names brought Peggy into a new relationship with language, one different from what has been characteristic of learning to read in the past.

Learning to read from print is necessarily a passive process for the child. Words on the page stand for other people's meanings. Until children start to write, they can't use written words for their own purposes. Microcomputers put reading and writing together from the start. A word that Peggy can read is also one she can use to produce on the computer effects that interest her. For Peggy, learning the alphabetic language has become more like every infant's learning of the vocal language. Speaking is powerful for the infant, even for one who commands but a few words, when a responsive person listens. Likewise, the production of alphabetic symbols—even one letter and one word at a time—can become powerful for the young child when computer microworlds provide a patient, responsive intelligence to interpret them.

Since speech is natural to man in all the various cultures of our world, it is reasonable to ask whether the most general and powerful elements in Peggy's experience with writing can be adapted for use in cultures other than the one to which she is native. If computer technology could make learning to read and write more like learning to speak and understand, it would be capable of changing profoundly the intellectual character of the world in which we all live.

The essential power available through the Logo computer language is that a word, any string of symbols, can be given a function. For example, the word "SUN" can cause the execution of a computer procedure which produces a graphic image representing the sun. Because both the spelling of a word and the meaning given to it are assigned through writing a procedure, the words of computer microworlds are independent of the "natural" language of the programmer. For example, the same procedure which creates the "SUN" could be given the name "SOLEIL" (French) or "JANT" (Wolof). Although computer words may be language-independent, anything made for use by people is culturally bound. Only people who share the same cultural experiences can know which objects and actions within a culture will be congenial to the children and will relate to the kind of homely experience which is close to their hearts and will continue to engage them in learning and loving learning.

The people who should determine what computer experiences are offered to children should be the children themselves, their parents or their teachers—or others who are close to the children and share their experiences—hopefully, sensitive, caring instructors with a progressive commitment to what is best for the children they love. Computers and their languages should be accessible to such people, easy for them to use as a casual, creative medium. If they are not so, the children of the world will not be properly served. ▶

▶ One lucky day, Peggy and I showed her BEACH microworld to two such men, Mamadou Niang and Moussa Gning. These gentlemen, Senegalese teachers who had come the New York Logo Center for an introduction to computers and the Logo programming language, were engaged by these microworlds I had made for my daughter. They told me that the Senegalese people are much concerned with the issue of literacy and hoped that computers could make learning the written word more congenial to the children of their nation. Their colleague and technical adviser, Mme Sylla Fatimata, later explained the importance computers could have to their children in this way.

The children of Senegal typically live in a personal, warm family setting until they are of school age. At home, they live and grow in the culture of their traditional languages, such as Wolof. At school age, they go off to a cold and impersonal place where all the language and all the lessons are French. Some children survive and thrive there, but many are terrified and refuse to learn. For them, learning in school means alienation from the people they love, and they reject that alienation even though they are encouraged to adopt it.

French is the dominant language through which the Senegalese deal with the exterior world. It is the language of opportunity within the government and commerce. Further, it is the language which has dominated the schools and continues to do so. The Senegalese intend to protect and advance their traditional languages by turning the tide of modern technology to their own use, specifically by developing literacy in Wolof among their children. Although Wolof has been written—in an extended Roman alphabet—for more than a hundred years, only during the last decade has the transcription of the language become standardized throughout the country. Consequently, and ironically, many learned people of their land, literate in French and even Arabic, are illiterate in their traditional language, the language they use in their homes and in conversation with their African colleagues at work.

Wanting to change this situation, the Senegalese believe they might better create programs for computer use in Wolof than in French or in the language of whoever makes the machines, and they have good reasons. Because there exists now no rigid "curriculum" for computer education in French, and because they have not invested years in teacher training in French language computer instruction, they imagine correctly that this new technology has a revolutionary potential which can be used to support their traditional language and culture if they but seize the opportunity.

With others of the Senegal Microcomputer Project, Mamadou Niang and Moussa Gning came to extend their introduction to Logo in Paris—at the World Center for Computation and Human Development. Because there is no better way to learn how to use a computer language than to use it for some significant purpose, I offered Mamadou this challenge, "You imagine some such microworld for the children of Senegal, and I will help you make it; let's work together to make something your young students will love." Mamadou noted that, of course, there are beaches in Senegal and the great city of Dakar, but that since an objective of their work was to appeal to all the children of Senegal, it would be more appropriate to think of images of the countryside. He proposed a village backdrop, with some small buildings and a well. To enliven such a scene, one would need people and the animals of the country life, perhaps a cat, horses, cows and so on. We agreed to make only a few objects, and thereby leave for the children the pleasure of creation; we would let them decide what they wanted in their world—and provide the tools for them to make it.

Since we come from cultures so much apart, it is appropriate to comment on our way of working together. We laboured to share ideas. Our working tongue, our *lingua franca,* was French: after all, in Paris *tout le monde parle français*. Mamadou and Moussa spoke French much better than I did. I was grateful that they would tolerate my poor French so that we could work together. The computer we used was an English language Logo computer. When they succeeded in helping me understand their objectives, I would propose and demonstrate programming capabilities and techniques to embody what Mamadou wanted in the microworld. In a kind of "pidgin" language, French, English, computerese, they began to program with my guidance a little scene, some designs of objects to fit in that scene, and some computer procedures to control their appearance and actions.

When we had created a scene with a number of French language procedure names—when we had the conceptual objects of this world more or less under control—we began to discuss using Wolof. This is where Moussa played a most significant role. As the leading primary-grade pedagogue for Wolof instruction in Senegal, he was able with confidence to assign definitive spellings to the procedure names we used to create and manipulate the objects of our village microworld. (Sometimes this involved consultation with the others of the Senegalese delegation, including the linguist, Pathé Diagne.)

Because the Logo language permits any string of "keyable" symbols to be the name of a procedure, we were able to convert French-named procedures such as "SOLEIL" and "MARCHE" to their Wolof equivalents, "JANT" and "DOXAL" (the "X" is pronounced as in Spanish). Thus we arrived at the assembly of procedures and designs capable of producing the village microworld, "XEW". (The sound of the name "XEW", meaning "scene", begins with the Spanish "X" and rhymes with the English "HOW".)

Photo © Robert Mohl, Paris

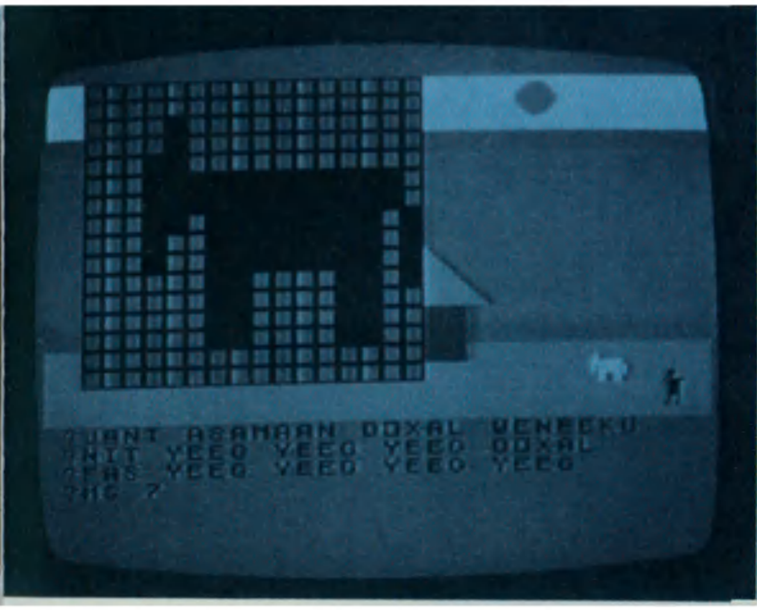
If the village microworld seems bare and crude, there is good reason. It was not made to impress programmers or civil servants. It is less a product than a project with a few examples of what is possible. This world is one to be created by the children of Senegal. Why should I tell them what they want? Why should even their teachers tell them what creatures and people to put in the worlds of their imaginations?

It was Mamadou who best expressed the right way of viewing the village microworld. When I said that the design of "FAS" was incredible, looked ever so little like a horse, he replied, "I'm sure the children will make a better one."

After their introduction to Logo—through the adaptation

Young Senegalese pupils manipulate the village microworld under the watchful eye of Moussa Gning.

Photo © Robert Lawler, Paris



"Redesigning" a horse.

Photo © Robert Lawler, Paris

of ideas for their country—my colleagues have returned to Senegal to begin a pilot project with children in the experimental classes of the *Ecole Normale Supérieure*. The first of the ideas that have been important in progress to this point was the adoption of Logo as their preferred computer language. Choosing Logo was important because Logo permits the definition of new computer procedures and because the language is both powerful and accessible. The second is the commitment to congeniality, to adapting ideas to maximize their applicability in terms of their own culture. This is the dimension where accessibility of the programming language to amateurs is important. Parents, teachers, and older children may know best what children will accept and love to learn.

The progress of the project in Senegal depends on understanding and extending studies now underway at the *Ecole Normale Supérieure* in Dakar. It also depends on the availability of suitable computer equipment. Their brave experiment could be one of the most important in the world; it deserves watching and support.

■ **Robert Lawler, Mamadou Niang and Moussa Gning**

The Senegal Microcomputer Project is supported by the World Centre for Computation and Human Development, Paris. The participation of Senegal was at the inspiration of Léopold Senghor and progresses with the continuing support of Jacques Diouf, Minister of Science and Technology, and Professors Bouna Gaye and Mohamadou Diallo of the Ecole Normale Supérieure. *The Logo programming language was developed by Seymour Papert and colleagues at the Massachusetts Institute of Technology and around the world.*

The computer generation

by O. Glissant, J.C. Maillard and M. Vertes

AS a result of the multitude of possibilities opened up by the computer, human societies are today moving firmly towards a greater mastery of science and technology. But is this development not leading us to neglect our past, our origins, so that we are deprived of our artistic and cultural heritage as we try to reduce the uncertainties of our future?

To answer this question we must first consider the advantages of the computer and assess the ways in which our world is being transformed by informatics, before trying to define the relationship between our past and this new technology.

The computer can perform a series of identical operations in which only the data vary. By considerably reducing the number of tedious and repetitious tasks that have to be performed, it saves time and increases the productivity of the brain. Because of the computer's ability to do a very large number of calculations at high speed, its user can examine the problem in hand more deeply instead of having to face the drudgery of doing the calculations himself. But it should never be forgotten that the microcomputer is simply a tool which is only capable of repeating and remembering what the user has taught it. Systematic use of the computer leads to a situation in which it carries out a number of tasks which the user could easily perform himself. Perhaps the computer-habit is causing man to lose awareness of some of his possibilities. It might be thought that over-use of the computer could cause computer-dependence, resulting in a loss of intellectual freedom and the risk of mental atrophy. Excessive use of the computer could also cut off the user from the world around him.

The appearance of the computer in schools is, however, leading to an irreversible technological and sociological change. We no longer acquire knowledge in itself; we acquire access to knowledge by means of the computer. Informatics is thus an intermediary between man and knowledge. In the United States a number of schools have already been created on this basis, with computers teaching basic reading skills and arithmetic and performing other tasks formerly carried out by teachers. Thus methods of work in schools have progressed considerably; instead of people solving problems, programmes are perfected in order to solve them. The real benefit of a programmable machine lies not in its problem-solving capacities but in the thinking that goes into the programming. This thinking consists of breaking down an operation into a series of directives which can be fed directly to the computer.


THE COMPUTER IS A TOOL...

The computer thus seems a remarkable means of liberating the user from drudgery. In a similar way, man might like to break free from the constraints of tradition which hamper his unending search for a better future. But what would be the value of a future built on no foundations? If man loses contact with his roots, with all that makes up his culture and personality, all that makes him both different from and interdependent with other people, what can he expect from a future which may be more or less well organized apart from a material comfort which is *derisory in comparison with the decadence which may well pervade his mind? Scientific development can in no way replace the role played by our artistic and cultural past.*

But in this case, is the impact of the computer on man not a harmful one? We wonder, on the contrary, whether the use of the computer, which has spread to so many of the modern sectors of the economy, could be extended to the traditional fields of culture and man's investigation of his roots. Can the study of the past be computerized? Will the conquests of technology give us a better grasp of history? Is this desirable?

Technically there is no reason why the computer should not be used for these purposes. The diffusion of culture through the combined action of informatics and telecommunications is perfectly feasible. The most insignificant piece of information is now at our disposal, and the computer should even make more information accessible to more people. The way thus lies open to the democratization of culture. Man has within his reach the means of attaching a new value to his collective past through the availability of this information.

If we want the computer's benefits to reach everyone, we should not limit its use to scientific activities. The use of the computer should be extended to traditional, cultural and artistic fields of activity in order to increase our knowledge of the origins of mankind.

In this way the computer could contribute to the construction of a future firmly rooted in the experience which can be derived from the past.

So far these possibilities have been insufficiently explored. But the computer's high level of rationality, which carries the risk of blunting our sensibility to nature, art and culture, should not be an insuperable obstacle. Such obstacles have always been overcome in the long history of human progress. ■

Olivier Glissant (aged 14), Jean-Christophe Maillard (aged 15) and Marc Vertes (aged 16) are pupils at the Louis-le-Grand Lycée, Paris.

Communications technology and development

by Ithiel de Sola Pool

ITHIEL DE SOLA POOL, *U.S. educator, has been professor of political science at the Massachusetts Institute of Technology since 1953. A fellow of the American Academy of Arts and Sciences, he is the author of a number of books on communications, including* Talking Back *(1973),* Handbook of Communication *(1973) and* The Social Impact of the Telephone *(1976). The present article has been extracted from "Technology and Change in Modern Communication", a document prepared for the International Commission for the Study of Communication Problems.*

THE developing countries of the world require large injections of technology transfer in the form of information if they are to have economic growth and development. The means for this, however, have been largely beyond their reach. Today a chasm separates the research facilities available in developed countries from the extremely limited research facilities in most of the world.

With the development of information retrieval technology, the gap could worsen, unless methods are devised to facilitate information transfer by new means. Given lack of money and skills poor countries cannot be expected to acquire comprehensive data bases; however, as low cost global data networks become available, they will permit remote access to the best information sources that exist.

If as seems likely, international data communications networks make access to data bases available from anywhere in the world at communications costs

Unesco's international programme for the development of communication

THE International Programme for the Development of Communication (IPDC) was established by a unanimous decision taken by the community of Member States of Unesco at the 21st session of its General Conference, held in Belgrade, Yugoslavia in 1980. Its statutes, rules of procedure and plans for future action are therefore the result of a consensus of opinion among the thirty-five nations which constitute its Intergovernmental Council and have the support of the Member States of the Organization.

This governing body has been given a challenging mandate. Composed of representatives proportionally divided among the Member States from all geographical regions of the world, this body has been called upon to work out, finance and implement a practical programme in order to reduce the existing gaps in communication within, as well as among nations. It must be proved that it is possible, in spite of political differences, to arrive at concrete and constructive decisions through co-operation and a willingness to listen and learn from each other.

Objectives

The main objectives of the IPDC are:

- to identify the needs and priority areas for the information and communication development plans in developing countries;
- to promote, in these countries and in accordance with their communication policies, the creation or extension of infrastructures for the different communication sectors as well as improved international exchange of information;
- to analyse the technical and financial needs and resources in the fields of information and communication at the national and international levels;
- to ensure better co-ordination and reciprocal consultation among parties interested in the development of communication;
- to secure funds, from both public and private sectors, to support these activities;
- to strengthen co-operation and co-ordination of Unesco's activities with other Specialized Agencies concerned, especially with the International Telecommunication Union (ITU);

Photo C. Fraser — FAO, Rome

Farmers at a co-operative near Piura, northern Peru, attend a training course developed under a project assisted by the United Nations Development Fund and the Food and Agriculture Organization. Robust modern portable video recording and playback equipment enables the course to be held at the farmer's normal place of work.

less than that of the mails at present, the information gap could rapidly be narrowed. A researcher in a university or planning office in a country without adequate reference sources of its own could retrieve a fact from a data base anywhere in the world for a communication charge little more than the cost of a domestic telephone call.

In short, as advanced countries increasingly transfer their reference materials from hard copy libraries to computerized retrieval systems, the underdeveloped countries will either fall further behind in information capacity, or will begin to catch up depending upon whether they are linked to these new information stores by telecommunications.

One common reaction to such suggestions for sustained interaction is fear of dependency. But in fact the use of the best scientific knowledge has the reverse effect. Given access to advanced knowledge, practitioners in less advanced locations will more quickly acquire the skills to become independent.

Suppose medical advice was provided to practitioners by global on-line query to data bases, and if necessary to live specialists. Medical practitioners everywhere would quickly improve their competence. Suppose that a new country linked its computer centre on line to a global network. Gradually, but fairly rapidly, young programmers and analysts would learn new skills. Doing things that they could not otherwise have done, they would develop expertise ▶

- to promote viable regional communication institutions, established with Unesco's assistance and which may play an extensive role in the planning and execution of regional projects within the programme;
- to provide consultative and advisory services to developing countries in the field of communication;
- to sensitize all parties concerned (be they developing or developed countries, international organizations and agencies of the United Nations system, non-governmental organizations or other public and private bodies active in this area) to the important role played by communication in the development process;
- to encourage maximum co-operation and concentration of efforts among those interested in communications development;
- to support the exchange of information, programmes and experience among media agencies, especially in developing countries;
- to prepare studies based on experience gained in international co-operation in the domain of information and communication development, particularly between developing and developed countries.

International dissemination and exchange of information by global satellite systems

A worldwide experiment in the transmission of televised news supported by Unesco's International Programme (IPDC) for the Development of Communication is due to start operating early in 1983, the World Communications Year.

This is one of three interregional projects planned within the framework of the IPDC, the two others being: a study of the application of communication technology to rural areas, and the establishment of a Centre for the study of communications, energy and space technologies. Some twenty regional projects have also been approved, as have a number of national projects in fifteen countries.

The project has the support of the regional broadcasting unions, both INTELSAT and INTERSPUTNIK having agreed in principle to take part in the experiment. Field studies, data-gathering missions and regional meetings have been held in Africa, Asia and the Arab States.

The project is planned in two stages: first, an experimental demonstration, and second, global interconnexion through the permanent leasing of transponders for collection and dissemination of television news and programmes.

The experimental demonstration will provide a simulated test of exchanges within and between these regions, as well as an opportunity to monitor the operation of their systems and their gradual integration with the present inter-union satellite exchange systems.

Since March 1982, a substantial amount of planning for the experimental period has been done by the broadcasting unions, the central co-ordinator and Unesco's Division of Free Flow of Information and Communication Policies. The experiment is scheduled to run for an initial eight-week period to test co-ordination procedures and gauge its effect on viewers.

▶ that they otherwise would not have had. They will start upgrading their own software and developing their own data bases. They will be conquering the main barrier to entering the computer game, namely the lack of trained humans with access to modern facilities.

Another objection often raised to developing countries investing in modern communications is that they should be using intermediate rather than high technology. They must learn to walk, it is said, before they learn to run. Poor countries, it is said, have unemployed labour and very little capital; they should use labour intensive processes, like hand-set newspapers, not capital intensive ones like computer composition. Besides that, it is argued, they should use things that they can make themselves (like the Indian chicken wire SITE antennas), not things that they have to import. Also, it is said—and this is more to the point—that there exist in every society traditional forms of communication, like folksingers, plays or sermons and that these have a credibility and meaningfulness in the culture which no imported impersonal form can have.

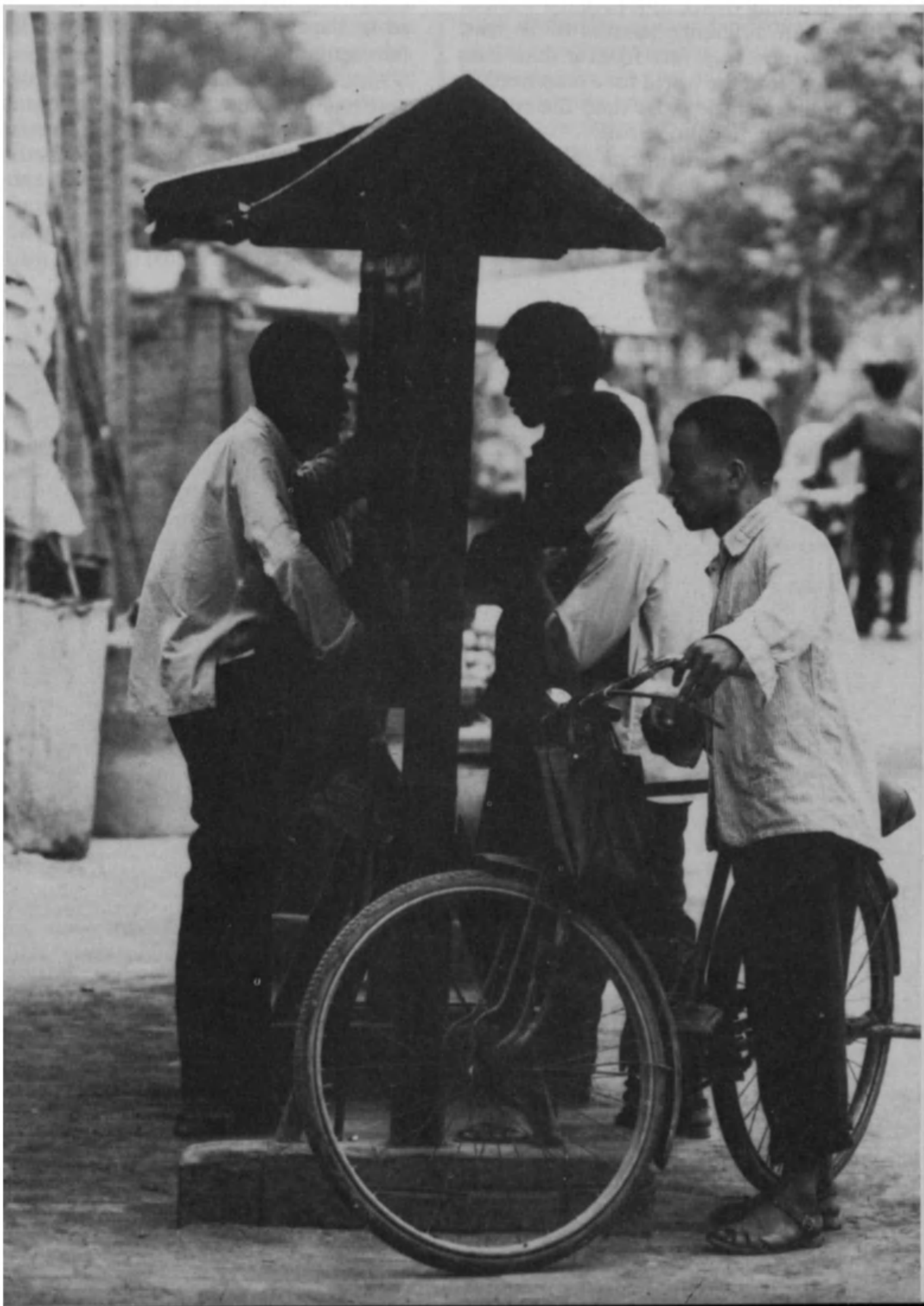
All of those arguments and particularly the last have a great deal of merit, but the cliché so easily leaped to, that high technology communications are inappropriate to developing countries, is a non-sequitur. Suppose that when the transistor radio first came into use someone had said that developing countries should not use that advanced technology, but should stick with conventional tube radios. We can see that transistor radios were cheaper, more reliable, easier to produce indigenously, more portable, and used less current. They were what developing countries needed and as a result they spread everywhere. Thanks to the transistor, radio has become the developing world's most pervasive medium.

It would be a mistake for poor countries to simply imitate the media institutions and practices of wealthier ones. In the United States and Europe, TV is a household good; in India it has been adapted to a village facility. In the West broadcasting is done almost entirely over the air; in China it was first done via wired loudspeakers. Since wired loudspeakers do not incur the monthly cost for batteries, a wired system was an appropriate early choice.

For a telecommunications system to serve an underdeveloped area effectively it must have certain characteristics. It should serve as an adjunct to expression by those persons who have credibility in the culture. It should use the language and the symbols of the culture. Its contents should be capable of local adaptation. It must be cheap. It should require as little foreign exchange as possible. It must also be reliable, relatively rugged, and not require highly sophisticated maintenance and operating personnel. It must operate even in the absence of an elaborate infrastructure of stable electric current, nationwide microwave relays or cable networks, and smoothly functioning telephone service. Finally it must link the underdeveloped region to any possible sources of data, not just to ones in a favoured metropole on which it is dependent.

These are not insoluble requirements. There are high technologies, intermediate technologies, and primitive technologies that meet many of these requirements, and there are high, intermediate, and primitive technologies that fail. Equipment in remote locations, where skilled maintenance men are few, should be highly reliable. Sometimes that favours solid state electronics (as in telephone switching); sometimes that favours manual methods. Developing countries have little foreign exchange for capital imports. Sometimes they can make advanced equipment for themselves, as in the case of the SITE ground station dishes; sometimes they cannot. Such considerations need to be looked at in detail in each instance. They cannot be bypassed by a verbal cliché about high or intermediate technology.

Among the communications devices that are most useful in developing areas are some well-tried means like a folk singer, or a traditional opera; some simple technological devices like a mimeograph machine, a slide projector, a wall newspaper, a super-8 movie



Reading the wall newspaper, in Beijing.

Photo Dilip Mehta © Contact Press Images, New York

School textbooks come off the press at the printing works established at Yaoundé by Unesco in collaboration with the Government of Cameroon.

Photo Gary Fullerton, Unesco

camera, or a wired loudspeaker; and some very sophisticated devices like transistors, electronic telephone switching, satellites and computer data networks. The value of the simple devices is recognized. What is sometimes denied is how well some of the new technologies match the requirements of poor lands.

International computer communications, using store and forward message switching, is a technology particularly well suited to the need of the less developed countries. It bypasses, rather than being dependent upon the problems of the ordinary phone system. For a voice telephone call, both parties have to be simultaneously present which can be very frustrating if it takes a couple of hours to complete the circuit. In a store and forward system the message waits in the transmitting computer until the circuit is available and then gets sent to its destined terminal at any hour of the day or night. Furthermore, low cost satellite receivers can be installed in remote regions, bypassing non-existent or overloaded microwave or cable land lines. Moreover, sophisticated data processing operations can be done by remote access to locations where the prerequisites exist. All that the local service must provide is the capability of carrying low speed code such as that which currently delivers telex or telegrams.

A four-media communication system seems likely to be appropriate in poor countries, particularly those with large terrain and scattered villages. The four media that seem most important are radio, satellite TV, satellite telephone, computer store and forward message delivery.

Radio is found everywhere. Television adds something to the effectiveness of educational broadcasting and to the quality of village life. However, it is too expensive to be owned by many individuals. Its appropriate use in the poorest areas is as a community facility. Where territories are small and densely populated, terrestrial transmission to the village set is economic, but where the territory is large and dispersed, the appropriate means of dissemination is by satellite as pioneered by the Canadians with their programmes to the Arctic, and by the Indians in the SITE programme. Telephony to remote locations can be delivered in the same way.

A sound development policy is one that creates communications facilities not only for the use of the central authorities, but also for the use of organizers at all levels. A single public telephone call box in a village provides a way of getting help in emergencies and of putting villagers in touch with their market. A tape recorder can be a useful instrument for getting feedback from illiterate villagers. Other grass roots media include mimeographed newspapers. Provincial broadcasting is important to countries like Nigeria where regional, tribal, and language differences are great. Voices talking in a strange accent from a remote capital are less credible than a local man who will be seen again the next day, and who will have to answer his neighbours about what he said.

Too little study has been done on possible use of such devices as the telephone or video recorder at the lowest rural levels. When developing countries invest in telephone development it is usually to improve the service in the capital and between the capital and other major towns. Large amounts are being spent on such programmes, and for good reason. They generally show a high return on capital, reflecting the high demand for telephone service. Such market-guided telephone investments, however, are rarely oriented in a major way to giving a voice to villagers who want to speak to nearby villages or to their district town. A rural village in a poor country is usually a tightly settled community where everyone is on top of everyone else.

The last need they are likely to feel is for a telephone in each house to talk to each other. The main function of village telephones is to allow villagers to be in touch with the market town and district officials. It is two-way communication; it allows the local nurse, or teacher, to make a request to their superiors as well as to receive instructions. It allows the farmer to enquire about the price on the market or ask whether the fertilizer has arrived. A single community phone may be adequate for years, and may be used only three or four times a day, but still thereby change the life of the village. That, at least, is the finding of the few studies of rural telephony that have yet been made. It is a subject that calls for more attention.

Opportunities for using communications to accelerate development are waiting to be picked up. There are three important sets of developments. It is becoming cheaper and easier to get mass media to the population because of low cost cameras and video editing equipment, satellites and low cost ground stations along with parallel developments in publishing. Secondly, international data networks are eliminating geography as a barrier to access to the world's best information resources; users can be on line to them from anywhere. Third, satellites and solid state electronics make two-way communication more feasible for even the most remote villages, bringing them into the national system.

■ **Ithiel de Sola Pool**

Satellite earth station near Caracas, Venezuela, for the transmission and reception of television pictures, telephone and telex communications.

Photo ITU, Geneva

The sky's the limit

OF all the applications of space technology, satellite communications is the most widely used. First utilized for intercontinental communication, satellites are now used primarily for international communication. However, they are also being used by a growing number of countries for domestic communication.

Satellites for international communication are operated by INTELSAT (International Telecommunications Satellite Organization), EUTELSAT (European Telecommunications Satellite Organization) and INTERSPUTNIK (International System and Organization of Space Communications). A global maritime communication system, INMARSAT (International Maritime Satellite Organization), went into operation early in 1982. Some countries have their own operational domestic satellite communication systems (Canada, India, Indonesia, USA and USSR); many others have plans to set up such systems soon.

A communication satellite is simply a wholly self-contained electronic switchboard in orbit around the Earth. There is one particular orbit, 35,800 kilometres above the Earth's equator, in which a satellite travels at a speed which keeps pace exactly with the Earth's rotation. To an observer standing on the equator a satellite in this "geostationary orbit" therefore appears to remain fixed in the sky directly overhead. By the use of properly designed antennas and electronic communication equipment, such a satellite can be used to relay telephone, television, numerical data and facsimiles between any two points on Earth which can "see" the satellite. Since each satellite can be seen from over a third of the Earth's surface, such satellites can provide a complete global communications network, able to link any two "ground stations" with each other.

In the early days of space flight, satellites were severely limited in mass (and therefore in capability) by the rockets used to launch them into space. The ground stations needed to interact with these satellites were therefore big, complex and expensive. With the advent of modern, high-performance rocket launchers and, perhaps even more important, the development of microelectronic circuitry, communication satellites today not only can handle thousands of simultaneous telephone calls and many television programmes, but also can transmit to and receive from relatively small, inexpensive Earth stations. This development, called "complexity inversion" because the most complex equipment has moved from the ground into the sky, is of considerable importance to the developing nations, who now have access to the global INTELSAT network at relatively low cost. It is far easier, therefore, for a developing nation to build low-cost ground stations and use the inexpensive satellite network circuit than to build a complete infrastructure of ground-based, hard-wire and microwave communication systems over their often difficult terrain.

As a result of the rapid development in satellite communication technology and the complexity inversion that went along with it, the per-channel cost of communications has decreased dramatically, even in the face of worldwide inflation.

But despite the low per-channel cost and the availability of inexpensive earth stations, the capital costs associated with the setting up of a satellite communications system are still substantial for many developing countries.

Communication plays a key role in development, to the extent that it transfers information, data and ideas. It is one of the principal elements in social advancement and economic development. It is therefore desirable that developing countries examine in detail the importance of satellite communication (especially to and from rural areas) as an integral element of their development. In rural communications, for example, the need is generally for only a small number of channels. However, most existing satellite systems are not designed for this application; instead, they are intended to carry the high-density, intercity traffic, and therefore their use for rural communication is "sub-optimal". For promoting rural communication, it is thus necessary that systems be specially designed to receive low-power signals, to transmit concentrated beams at high power, and to provide on-board signal regeneration and switching whenever feasible. Further, ground terminals should be as inexpensive as possible and be capable of operating from standard batteries. Current developments in enhancing satellite on-board capability are leading in this direction; inexpensive ground stations as small as wristwatches appear to be possible in the near future. ■

This text is based largely on a UN brochure on The Use of Outer Space for the Solution of Earth-bound Problems, *published for* Unispace 82, *the Second United Nations Conference on the Exploration and Peaceful Uses of Space, held in Vienna, August 1982.*

Community radio for Kenya

by Jack Mills and James Kangwana

AT the beginning of May 1982, the Homa Bay Community Broadcasting Station in Kenya's Nyanza province started regular transmission in the local language, *Luo*. Manned by a producer from the national Voice of Kenya (VOK) network and three assistants, the station puts out one-hour daily programmes covering local news, problems of health and family planning, as well as news in Kiswahili relayed from VOK.

Most of the programme materials are gathered through interviews in the market place, on farms, in schools and with organized groups like the local women's organization.

Homa Bay is a town of some 10,000 people, situated on the shores of Lake Victoria about 450 kilometres by road west of Nairobi. The main occupation of the people is farming, especially cattle rearing, and fishing. The town was chosen as the site for a Unesco community broadcasting project, the aims of which were to establish in an African country a low-cost rural broadcasting station with equipment designed and built with the full participation of staff from the host country. The system was to provide an alternative to the usually expensive imported broadcasting equipment which sometimes proves equally expensive to operate and maintain.

The Unesco project was designed to take account of a situation in which sound broadcasting faces many problems. In terms of coverage and utilization, the medium is more important than television in African countries, but even so the continent has only about 3 per cent of the world's transmitters, and on average only about 7 per cent of the population has access to broadcasts from these transmitters, which are generally located in or near to towns and cities. Very few transmitters cater specifically for the rural areas where most of the population lives and where the need for the benefits of communication infrastructure is greatest. The principal concern of the Unesco project was the provision of nationwide coverage at least cost to the economy.

JACK MILLS, *of Ghana, is a consultant to the Economic Council for Africa (ECA) and to Unesco. He was formerly chief engineer and deputy director-general of the Ghana Broadcasting Corporation.*

JAMES KANGWANA, *of Kenya, is project co-ordinator of Unesco's Manpower Development Project for East Africa. He was formerly director of the Voice of Kenya (VOK).*

The extension of sound broadcasting to rural communities can be achieved by equipping the centralized national network with more powerful transmitters. However, this is not the most satisfying solution because the output is seldom related to the needs of the rural community it purports to serve. Programmes originating from the towns and cities and beamed to the rural dweller have often failed to achieve their objective, for a number of reasons.

Firstly, very few African countries have a common language which can be used for effective communication with their rural populations. In some countries there may be over sixty different rural languages and numerous dialects. The best that the broadcasting organizations can do under these circumstances is to select what are considered the main languages or vernaculars, usually not more than ten, and broadcast daily programmes in these languages on a time division basis. Thus no one community listens to the language it understands for more than a few minutes a day.

Secondly, the local language programmes are often produced by city dwellers who are not fully acquainted with the way of life of the rural population and do not fully understand its needs. The result is that listeners eventually lose interest in the programmes.

Thirdly, the distance of some rural areas from the national transmitters are such that only weak and unintelligible signals are received.

Hence there is a strong need for technologically independent, community-centred systems which are capable of being hooked up to the national system by microwave links or off-the-air pick-ups. However, the cost of doing this using current technology can be prohibitive for most African countries. One of the aims of the Unesco project was to show that the engineering and technology required for the production of broadcasting equipment need not be as costly as the price of imported articles would indicate.

The project involved a series of feasibility and costing studies, as well as the study of sound broadcasting systems currently in use in 11 African countries. Following this groundwork, Kenya was chosen as the host country for the on-site fabrication and testing of a model broadcast Audio Mixer; the ▶

Schematic diagram of the Homa Bay community radio transmitter.

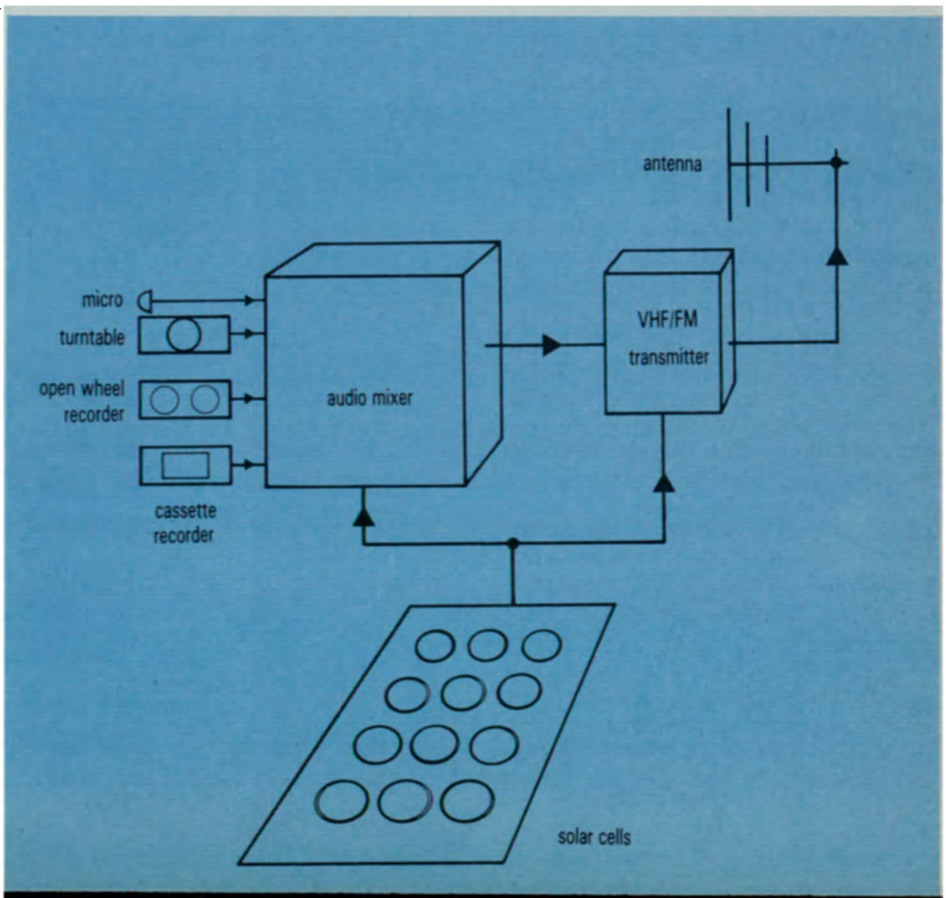


Diagram Unesco

▶assembly and testing of a low-power transmitter; the installation of the completed equipment in a rural location; and the carrying out of a field strength survey of the model station.

It was decided that the station should use an easy-to-maintain, low output power, VHF/FM transmitter. Power consumption with this type of transmitter is low and it could therefore be powered by solar energy. VHF/FM had various other advantages, including simplicity of construction. On the other hand, the main disadvantage of VHF transmission is that its propagation is by "line of sight"; because of this, nearby hills and mountains form obstacles to the waves, thereby "shielding" would-be reception areas from the transmissions. Medium waves, which rely on "ground waves" for their propagation, do not suffer this defect.

The approach was to produce equipment using a technology that would not be too unfamiliar to engineers in the African broadcasting organizations, but that would at the same time make use of new electronic circuit techniques. The objective here is an educational one—to enable the engineers to use some of these new techniques to build similar equipment in their own establishments, thereby cutting down on the cost of imported electronic equipment.

In line with this approach, the use of operational amplifiers with discrete components was chosen as a means of introducing integrated circuits, which will be the inevitable choice in future design where low cost and simplicity are the main objectives. The advantage of the discrete design is that it introduces the principle of operational amplifiers which are the building blocks of integrated circuits. An electronic building block was developed which is versatile enough to be used throughout the Audio Mixer for microphone, gramophone, tape and other input channels. Printed circuit boards were used because they simplify assembly and enable the sub-sections of the design to be repeated.

Unesco was responsible for training the African engineers and technicians in charge of the project and provided all the parts for the construction of the Audio Mixer and the Transmitter. Almost all the electronic components used in the Mixer were imported, their total cost amounting to $566. The Transmitter is a direct VHF/FM transmitter with a power output of 10 watts. Again almost all the component parts were ordered direct from overseas. The main transmitter unit cost $266.72, the power unit $70.90.

Work on the fabrication of the Mixer and the Transmitter went quite smoothly. The sixteen channel modules for the Mixer and the power supply unit were completed within four weeks of the start of the work, 24 June 1981, and the assembly of the modules on the "mother board" and testing were completed three days later. The supplying and cutting to size of the Mixer's metal panels and the drilling of holes according to drawings and spraying were done in the workshops of Kenya Railways.

Preliminary testing of the transmitter in Nairobi revealed that the signal could be received about two kilometres away. The complete station was then transported on a VOK bus to Homa Bay for the final test. The equipment was installed in the Kenya National Union of Teachers building.

With a mast height of 24.4 metres, the coverage area includes the whole of Homa Bay township. The farthest places reached by adequate signals (about 2 mV/m) are Gendia, a health post 27.5 kilometres from Homa Bay, and Kirindo, a State Irrigation Project site 23.5 kilometres away.

Installation work at Homa Bay was not as smooth as the fabrication work in Nairobi. Almost all the installation material had to be brought from the capital since the local stores do not stock materials for which local demand is non-existent. On the other hand, the local artisans were found to be quite good, provided the materials they required for their work were supplied. All the woodwork for the studio acoustical system was done by local artisans.

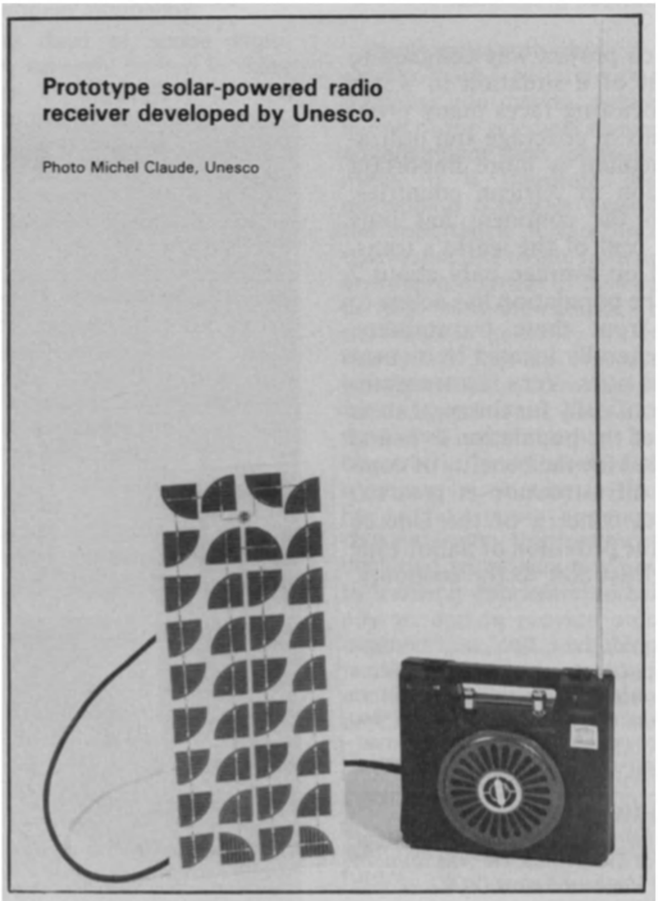
Before broadcasting began, a detailed cultural and socio-economic profile of Homa Bay was prepared by a Unesco consultant. This was followed by training of three producers by another Unesco specialist. Training covered studio operations; announcing techniques; preparation and recording of interviews and discussions; recording of singing groups inside and outside the studio; and orientation on rural and community programming. At present the station broadcasts between 5.45 p.m. when farmers and other workers are expected to be back at home, and 7.00 p.m., but a more extensive programme schedule will come into operation when the station is officially commissioned.

On the whole, the objectives of the project have been achieved. Although the locally fabricated equipment lacks the sophistication and complexity of the imported type, tests have shown that its performance is not below that of imported counterparts; it can be used to achieve the same objectives at much lower cost.

Although the station has not been officially commissioned, requests are already being received from owners of FM receivers for certain programmes to be repeated and in some cases special music to be played back. Some of the residents even walk into the studio and ask to be interviewed about their work and life.

Rural broadcasting as envisaged by the project is new in Kenya, and new for that matter in almost the whole of Africa. It is hoped that with time and the present interest being shown by the people of Homa Bay, it will eventually achieve its objectives and spread to other parts of the continent.

■ **Jack Mills and James Kangwana**



Prototype solar-powered radio receiver developed by Unesco.

Photo Michel Claude, Unesco

MISSING LINKS

In many parts of the world it is possible to hear the news from Paris, Moscow or New York and yet not know what is going on in the next door village. In projects all over the world Unesco is attempting to forge the "missing links" in the world communications network.

Photo © Carlos Arnaldo

Photo © Knud Ebbesen

Photo © H. Jan Forsman

Old sugar sacks, scraps of cork panels and straw matting were used as acoustic baffling for this broadcasting studio (top left) built at the capital, Praia, by Cape Verde's new educational radio unit. The portrait on the left hand wall is of Amilcar Cabral, the architect of Cape Verde's independence. Nineteen prospective radio producers were trained for this unit as part of a Unesco-Federal Republic of Germany Educational Radio Project which also included the installation of new radio transmitters on the islands of Sao Tiago and Sao Vicente.
Above, near Kotmale, a Sri Lankan radio producer records sounds of the countryside for mixing into a community radio programme, under a project assisted by Unesco and Danida, the Danish development agency. Left, an Indian Unesco consultant (left), a Fijian assistant engineer (right) and a Tuvaluan technician (centre) prepare cabling for a voltage stabilizer to power the Tuvalu (formerly the Ellice Islands) national radio transmitter, provided by Unesco and the United Nations Development Programme.

A Unesco-sponsored plan for the creation of a unique regional information service will come to fruition when ALASEI (the Latin American Special Information Services Agency) becomes operational later this year. The main purpose of the new agency will be to meet the special needs of Latin American peoples and countries in their advance towards autonomous endogenous development and to handle information that existing agencies either ignore or deal with incompletely. The new agency will consist of a series of national and sub-regional bureaux with journalistic production, editing and distribution functions and a central office which will handle material from the national offices and provide "features" on regional topics. ALASEI will be equipped with a high grade satellite communications system. Right, the convent of Santo Domingo, Panama the country in which the ALASEI Action Committee is now based.

Photo © Gustavo Nacht, New York

Letters to the Editor

Poetic justice

Sir,

The *Courier* continues to impress and please me with its selection of themes and the quality of its content.

The issue of November 1982, "War on War", is no exception. I do, however, wish to record some points of criticism.

War and militarism might well have been put in context. War springs from and is only one manifestation of *violence* in the minds of men, violence which is nurtured by the structures of our societies. Yet nowhere in the poetry or the texts is the word "violence" used. It is true that the selection from Breytenbach makes my point. He is not talking of war; he is speaking of a violent society. The same is true of Cardenal and Faye.

I would have taken "The Covenant" of Thiago de Mello as the theme piece, and titled the issue "Warriors against Violence" (in ourselves, our homes, our cities, between nations, etc.). It is when frustration with the basic manifestations of violence become unbearable that leaders—and people—resort to organized war.

Stephen Spender's main point, at the conclusion of his article, is partially *apropos* of my feeling: "Antiwar poetry is not only against war. It states the predicament of life against destructive technology".

While agreeing with much of what Jean-Jacques Lebel says about poets and poetry, I take exception to his observation that "the other forms of expression... have proved incapable of comprehending the present world crisis". The conceptions, inspirations and writings of a number of scientists have contributed beautifully (one might say "poetically") not only to understanding but in suggesting paths toward more harmonious relationships, man to man, and man to nature.

John E. Fobes
Webster, N.C. USA

Mr. Fobes was formerly Deputy Director-General of Unesco—Editor

Images out of focus

Sir,

I was pleased to see my photograph in the July 1982 issue of the *Unesco Courier,* but dismayed to read its caption. While I cannot argue with the truth of the statement in general, that "the children of migrant and minority groups become the victims of institutionalized procedures that preserve the *status quo,*" I would reject its application here.

The classroom pictured is a kindergarten section of the Riverside Church-Kindergarten School, which serves the Upper West Side and Harlem communities in Manhattan. There is probably no school setting in the country freer of racial prejudice. The congregation of the church itself is, or was when my children attended the school, roughly half black, half white, and racial minorities are well represented on the teaching staff. The school deliberately strives against discrimination, and evenhandedness in matters of race is an important policy of the whole institution.

I did not identify my photograph's setting. Therefore, an editor would have no idea where it was taken. Still, I thought I would let you know that there is such a place as Riverside Church, and what it stands for.

Jeanne Hamilton
New York City

Sir,

In your July 1982 issue you illustrated Han Suyin's article with several vivid photos accompanied by captions. With reference to the photo captioned "Immigrant workers in the shanty-town at Saint-Denis", I should like to point out that you used an out-of-date photo since the last shanty-town at Saint-Denis was destroyed and its 5,000 inhabitants rehoused in a modern estate on the same site in 1968.

Colette Boucher
Assistant Mayor,
Saint-Denis,
France

Apologies all round. Editor.

BOOKSHELF

■ **Many Voices, One World,** Communication and Society Today and Tomorrow. Report by the International Commission for the Study of Communication Problems. First published 1980. A Unesco co-publication with Kogan Page, London, and Unipub, New York. 312 pp. (60 F).

■ **Film Animation: a Simplified Approach,** by John Halas. 2nd imp. 1979. 92 pp. (14 F); ■ **Audio Cassettes: the User Medium,** by Sumanta Banerjee. 1977. 56 pp. (10 F); ■ **VTR Workshop: Small Format Video,** by Loretta J. Atienza. 2nd imp. 1979. 114 pp. (16 F); ■ **Rural Radio: Programme Formats,** by Kiranmani A. Dikshit, and others. 1979. 94 pp. (10 F); ■ **Small Printing Houses and Modern Technology,** by Roger Jauneau. 1981. 98 pp. (16 F). All titles in Unesco's **Monographs on Communication Technology and Utilization** series.

■ **Mindstorms.** Children, Computers and Powerful Ideas, by Seymour Papert, Basic Books, New York, 1980 ($6.68) and Harvester Press, Brighton, UK (£9.95).

■ **The Microelectronics Revolution.** The Complete Guide to the New Technology and its Impact on Society. Edited and introduced by Tom Forester. Basil Blackwell, Oxford, 1980. 589 pp. (paperback £5.95).

■ **Technology Showcase.** Guide to the Telecom Technology Showcase permanent exhibition, Baynard House, 135 Queen Victoria Street, London EC4.

■ **The Computer Book.** An introduction to computers and computing, by Robin Bradbeer, Peter de Bono and Peter Laurie. British Broadcasting Corporation, London, 1982. 208 pp. (£6.75).

■ **L'Informazione. Teoria ed Evoluzione Storica,** by Domenico de Gregorio. Presidenza del Consiglio dei Ministri. Direzione generale delle informazioni, dell'editoria e della proprieta letteraria, artistica e scientifica. Rome, 1981.
(Domenico de Gregorio is editor of the Italian edition of the Unesco Courier).

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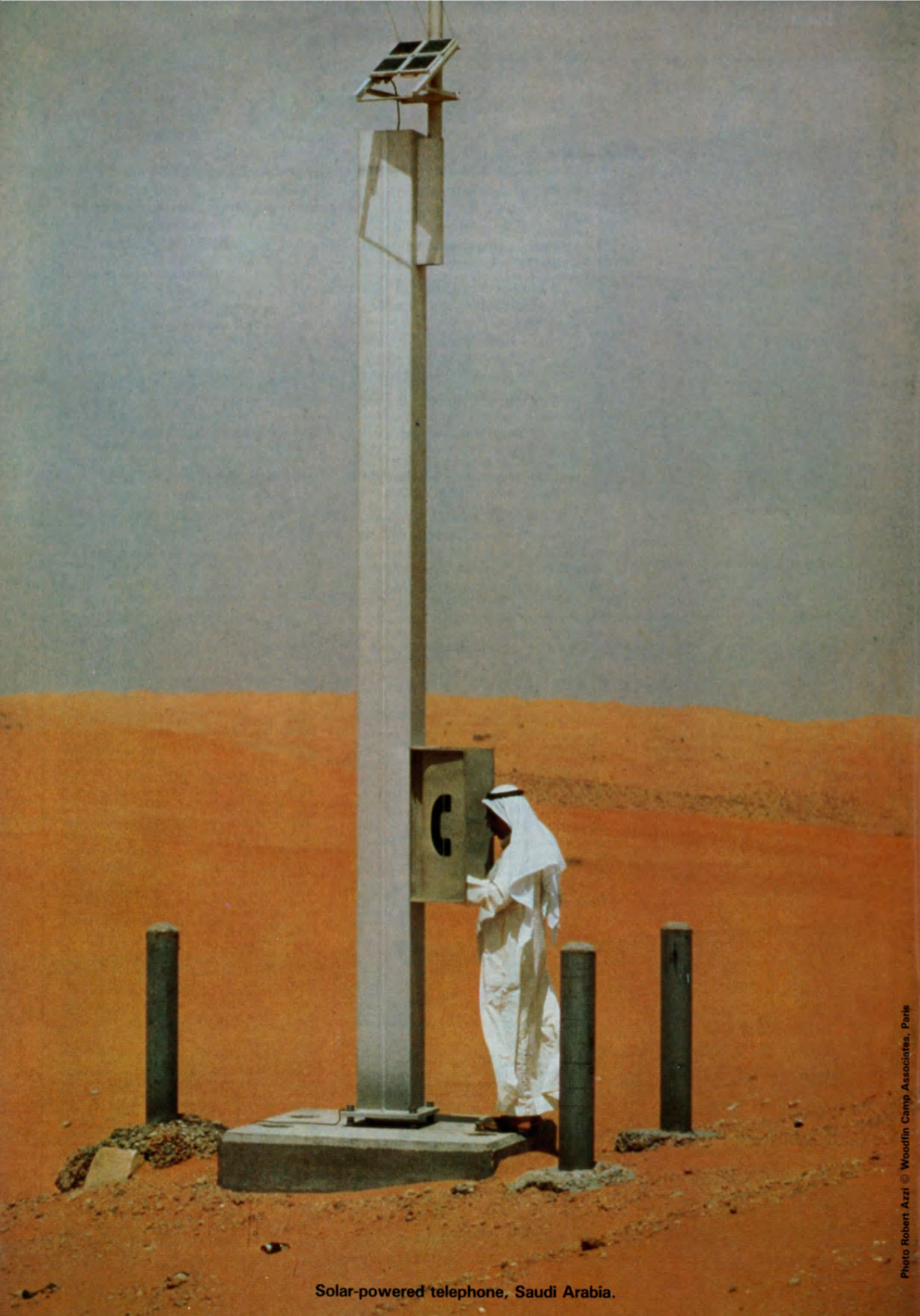

Solar-powered telephone, Saudi Arabia.

Photo Robert Azzi © Woodfin Camp Associates, Paris