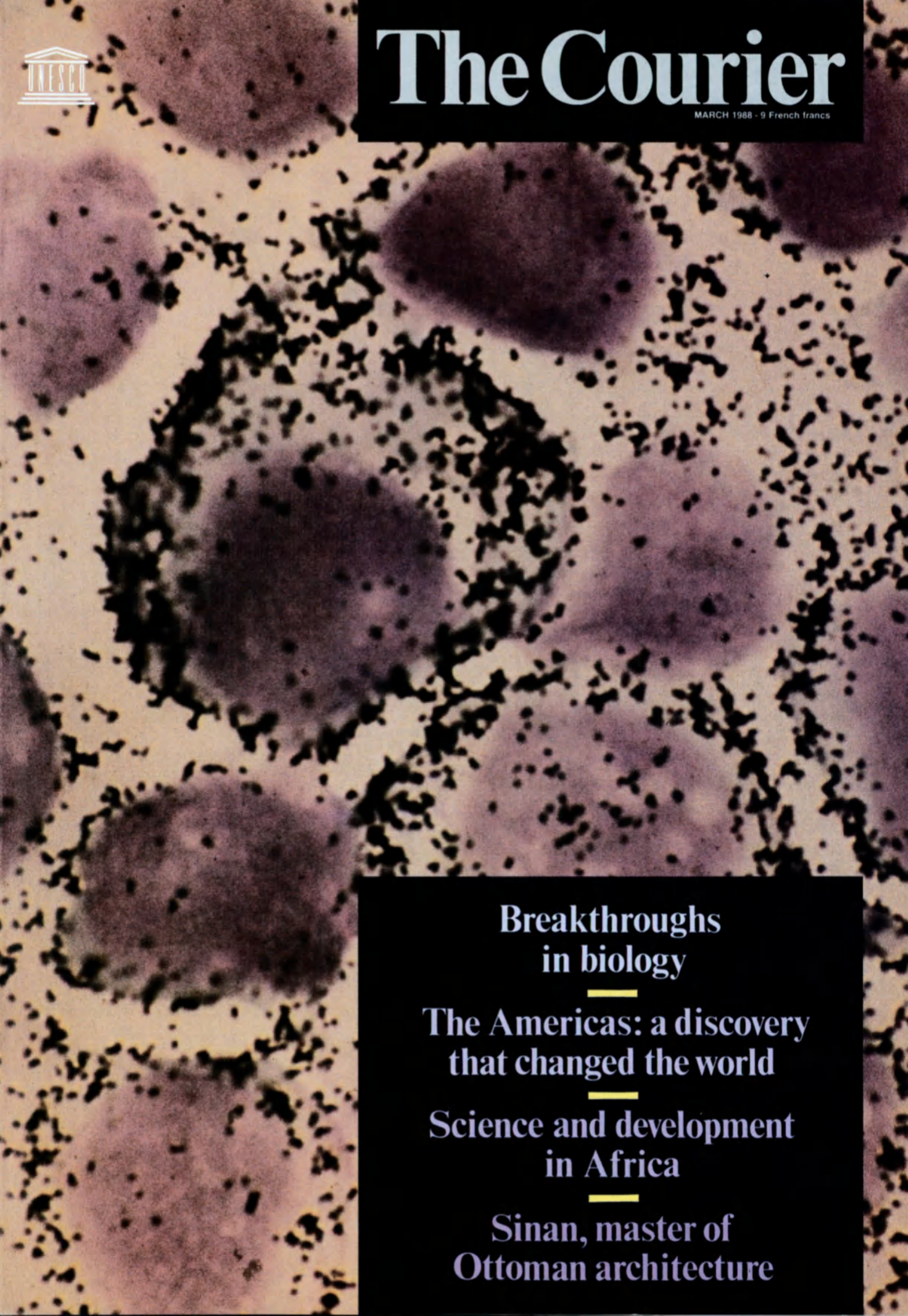

The Courier

MARCH 1988 - 9 French francs

Breakthroughs in biology

The Americas: a discovery that changed the world

Science and development in Africa

Sinan, master of Ottoman architecture

3 *Niger*

Photo © Almasy, Paris

Over to you ...

The vast continent of Africa, with a population today of over 500 million, is experiencing a development crisis. While science and technology play a vital role in helping to find a solution, as this issue of the* Unesco Courier *points out, emphasis on the cultural dimension of people's lives is also fundamental in any effort to mobilize an entire continent. All the means of self-expression available today must be used in order to broaden access to, and participation in, cultural life. Above, a journalist interviews a village woman in the Republic of Niger.

March 1988

Cover: View of Hepatitis B virus in a cancer of the liver, using an optical microscope
Photo Fournier © INSERM, Paris

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editorial

This issue of the *Unesco Courier* offers a voyage of discovery: scientific, geographic, historic, cultural, artistic and humanitarian.

We have taken the life sciences as a point of departure. Can any science be richer in potential discoveries than contemporary biology? The ability to explore the infinitely small, to isolate and study genes, those units of hereditary information which are basic to life, gives biology an often disturbing power to investigate and intervene that places it in the vanguard of modern science. Visions of the "outer limits" of life are evoked for us by the noted biologist Professor François Gros in his account of some of the marvels emerging from the indefatigable laboratory explorations of today's Marco Polos.

When the discovery of the Americas is referred to, especially in the Spanish-speaking countries, it brings to mind the arrival of Europeans in the New World, the fifth centenary of which will be commemorated in four years' time. Is "discovery" the correct word to use in describing this event? For Europeans there was most certainly a discovery, but was it the same for the peoples of the Americas, for those who were "discovered"? As the Venezuelan writer Arturo Uslar Pietri points out, 12 October 1492 in fact marked the beginning of a pattern of universal cultural exchanges and mutual influence, a process which transformed the entire world and which is still taking place today.

We also take a look at the young art of African cinema, which may be a discovery for many readers, whatever continent they come from. In the short space of thirty years, African film-makers have produced works which rank with the great classics of world cinema.

Other discoveries to be made in the following pages include the Convent of San Francisco, Lima, a masterpiece of Spanish colonial art on which urgent restoration work is currently being carried out; and the superb mosques built more than four centuries ago by the Turkish architectural genius, Mimar Sinan.

Finally, we draw attention to the urgent need to display solidarity with Africa, whose plight is one of Unesco's major preoccupations, in two articles which analyse the development of science and technology in that continent. A large proportion of the world's population live in Africa, often in conditions of extreme poverty, influenced by the effects of a serious crisis that can only be overcome with the aid of a science and technology policy fully adapted to African needs.

Editor-in-chief: Edouard Glissant

The changing face of the life sciences

by François Gros

IN comparison with its antecedents, contemporary biology presents a dramatically altered image to the world. Not only is it in the process of revolutionizing medicine, agriculture and the environmental sciences, it is also calling in question, through the epic adventure of modern genetics, the very nature of the species *homo sapiens*. We are far from the poetic reveries of Jean-Jacques Rousseau's botanizing "Solitary Walker", or the attempts of nineteenth-century comparatists to determine the laws of evolution. Biology has been transmuted into an exact, computerized, strangely disturbing science which has spawned marketable technologies that are profoundly modifying the industrial scene and the balance between the industrialized and the developing countries.

The decisive turning point was reached in 1973, the year which saw the birth of the new and revolutionary discipline of genetic engineering, which derived directly from molecular biology. For the first time, the general public became truly aware that the life sciences existed and were capable of exciting a degree of passionate concern rivalling that aroused by nuclear physics.

Political and industrial decision-makers were quick to recognize the birth of a modern technology and to perceive the important practical consequences it could be expected to have on the overall economic equilibrium of the planet. From being primarily a "contemplative" science, biology has become an active, manipulative science, and even at times, unfortunately, a target for speculators.

At this point I would like to give a few examples of some of the most significant achievements of contemporary biology.

Mapping the human genome

In addition to making it possible to control at will the biosynthesizing capabilities of unicellular organisms, genetic engineering techniques have led to the development of marker devices known as "genetic probes". It is now possible to envisage the use of these probes to draw up an accurate map of the human genetic make-up. Using recombinant-DNA technology[1] (see the *Unesco Courier,* March 1987), scientists have succeeded in cloning[2] fragments, varying in size, of chromosomes taken from human or animal cells within the cells of micro-organisms.

The micro-organisms propagate and amplify these chromosome fragments which can then be sorted and purified. Once they are available in sufficient quantity to be analysed, they can be subjected to two further operations. The first of these, known as *physical mapping* (or *restriction-enzyme mapping)* consists of identifying the fragments by studying the manner in which they are cleaved by a battery of restriction enzymes.[3] The second, known as *sequencing,* consists of determining their chemical sequence, that is, the order in which their constituent elements are linked together.

Before the advent of genetic engineering the existence of genes could only be inferred from the consequences of mutations of which they are the site. Evidence for hereditary traits was found by studying change in an eye pigment, in the morphology of a limb, the behaviour of an animal, or in susceptibility to a given disease. Once tracked down, as it were, its site in the chromosome was usually deduced from studies of crossing based on the frequency of liaison or segregation of characteristics during the recombination of parental chromosomes. Finally, it was possible, under favourable conditions, to reveal certain alterations in chromosomes (splitting, transposition, amplification) by observation using optical or electronic microscopes.

Genetic engineering has made it possible to "materialize" the gene. Representing little more than a millionth part of man's physical inheritance, the gene can henceforth be isolated as a molecule; it has become, technically speaking, "workable". Not only can it be analysed, it can also be manipulated and, thanks to restriction enzymes, be subjected to micro-surgery. In short it can treated like any other molecule.

All this has had many consequences for our fundamental understanding of life. It has led, for example, to the discovery of the genetic mechanisms responsible for the diversity of antibodies, to precise study of individual genetic polymorphism, and to the discovery of cancer-bearing genes, or "oncogenes". For the time being, however, let us take a look at some of the medical consequences, in particular the study of hereditary diseases.

Locating defective genes

Every year in France, thousands of children are born suffering from serious hereditary diseases. These afflictions, which account for 50 per cent of infant mortality, include muscular dystrophy, mental disorders, intolerances due to metabolic error, mucoviscidosis (cystic fibrosis), blood disorders, X-chromosome fragility, serious immuno-deficiency (an affected child may have to be enclosed in a sterile "bubble"). But this is only the tip of the iceberg. In fact, as the fund of genetic knowledge increases, doctors and biologists are becoming aware that, from birth, our genes bear within them a number of risk factors and susceptibilities, even when they are not subject to the serious mutations that are responsible for the monogenic[4] diseases. The French geneticist Jean Dausset's discovery of genes whose properties control compatibility or reaction to organ or tissue grafts between individuals has shown that certain mutations within these genes increase considerably, sometimes by a factor of over one thousand, the predisposition to such serious illnesses as ankylosing spondylitis, rheumatic fever and auto-immune disease.

The ability to establish the chemical sequences or physical organization of genes opens up wide prospects for pre-natal or pre-clinical diagnosis. Such early detection was already possible by examination of the karyotype[5] or of enzymes, but these tests were not very reliable and, above all, could not be carried out until a relatively late stage of foetal development. Diagnosis using genetic probes, on the other hand, can be made from the eleventh week. A dozen or more serious illnesses can thus be detected and the nature of the mutation pinpointed.

Moreover, this new field of genetics may open the way to a grandiose project that has aroused as much public interest in the United States of America as the problem of AIDS. The proposed project involves establishing the sequence of the 3,500 million chemical elements that make up the

Breakthroughs in genetics and immunology take biology into the third millennium

A biological research laboratory

complete genetic code enclosed within man's forty-six chromosomes. The hope would be that we would thus be in a position to locate the very large number of mutations responsible for hereditary diseases whose primary causes are as yet unknown. Out of nearly 3,000 hereditary diseases that have been described in the medical literature, it has so far been possible to link no more than a few dozen with any certainty to a corresponding genetic mutation. Of the 100,000 to 150,000 human genes, barely 1,500 have been "located" and for only 500 of these has the chemical sequence been established.

It is not our purpose here to enter into the discussion as to whether there is sufficient justification for such a project, which would cost nearly 1,000 million dollars and occupy hundreds of research workers for from ten to fifteen years. Yet the fact that it has been proposed shows the extent to which the recombinant-DNA technique has revolutionized genetics. Moreover, we have not as yet mentioned its therapeutic possibilities.

"The ability to establish the chemical sequences or physical organization of genes opens up wide prospects for pre-natal or pre-clinical diagnosis." Below, a genetic research worker makes a montage of human karyotypes.

Photo Michel Depardieu © INSERM, Paris

It has been known for some five years now that a foreign gene will function normally when inserted into a somatic cell, such as the lymph cell of human bone marrow. Hence the idea of grafting "normal" genes to compensate for defective genes by implanting into a patient some of his own bone marrow cells in which the "normal" gene has already been inserted. Specialists believe that it will soon be possible to envisage the use of these "prosthetic genes", in particular to save the lives of children suffering from immuno-deficiency.

Oncogenes

Molecular biology and genetic engineering have opened up a new approach to human biology and medicine as they relate to cancer. With the discovery only some twelve years ago of a special category of genes, the so-called "oncogenes", we are now for the first time in a position to explain the genetic origin of cancers and their occurrence linked to mutations and viral attack.

The main families of carcinogenic viruses were described at the beginning of this century. The first was identified in 1914, at the Rockefeller Institute of New York, by the American biologist Peyton Rous. Rous drew attention to a virus which, in a few weeks, produced sarcomas in chickens. Since then over thirty carcinogenic viruses have been isolated. Over the last ten years, the conviction has grown that many human cancers are linked to oncogenic viruses. The most well known are Hepatitis B virus, frequently associated with primitive cancer of the liver in the tropical zones, the Epstein Barr virus, which is one of the elements responsible for cancers of the jaw in Africa and Asia (in Europe it causes the benign condition of infectious mononucleosis), and the papillomavirus, responsible for cervical cancers. Mention should also be made of the RNA or retroviruses, which include the HTLV1 and HTLV2 viruses associated with leukemia, as well as the unhappily celebrated viruses responsible for AIDS, known under the labels of LAV, HTLV3 or HIV, which provoke certain cancers such as the Kaposi sarcoma.

It had been recognized that the carcinogenic effect of these viruses was linked to the presence of a particular gene which was an integral part of the hereditary make-up. However, much surprise was caused by the discovery in 1976 that all animal cells (including human cells) contained in their chromosomes, even when these were perfectly healthy, genes very similar to those previously detected only in viruses. Among the 100,000 or so human genes, only about thirty oncogenic genes have so far been detected. This amazing discovery has provided some explanations of phenomena of great importance to the understanding of the mechanisms of tumour formation:

1. There is an obvious explanation for the existence in carcinogenic viruses of determinants[6] specific to cancer genes: the viruses have "stolen" them from cells they previously infested. The mechanisms of the exchange between a cell's hereditary deter-

Photo M. Montcany © INSERM, Paris

The dystrophies are inherited diseases characterized by progressive weakening and atrophy of different groups of muscle tissue. (1) Diagram of an normal X-chromosome. Arrow indicates the position of the abnormal gene responsible for Duchenne's dystrophy—a muscular degenerative disease named after the 19th-century French neurologist who first described it. (2) Photograph of a normal X-chromosome. (3) Photograph of an X-chromosome from a patient suffering from Duchenne's dystrophy associated with other diseases. Arrow indicates the position of the defective gene. (4) Photograph of the two X-chromosomes from the patient's mother, one normal (black arrow) and the other abnormal (white arrow).

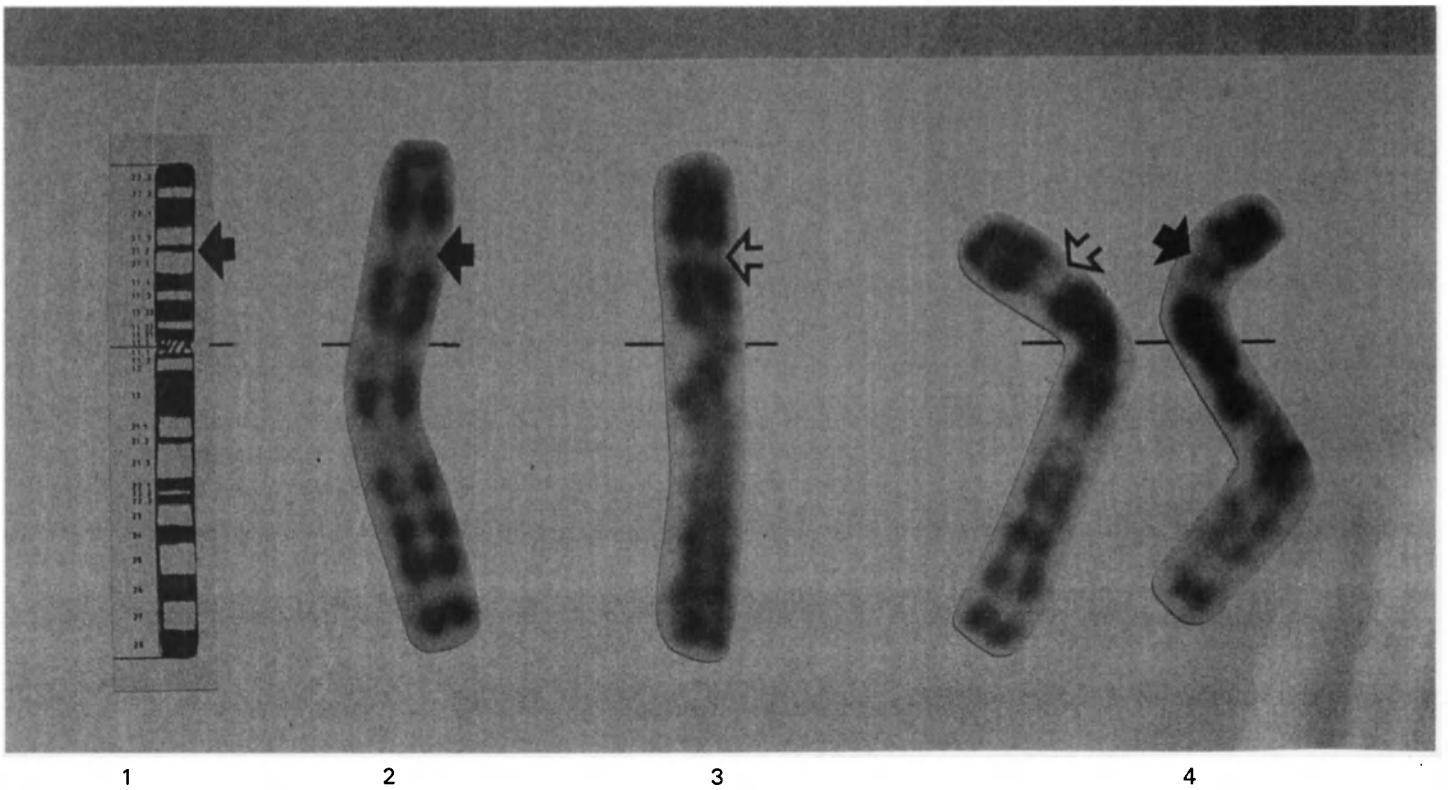

Photo © INSERM, Paris

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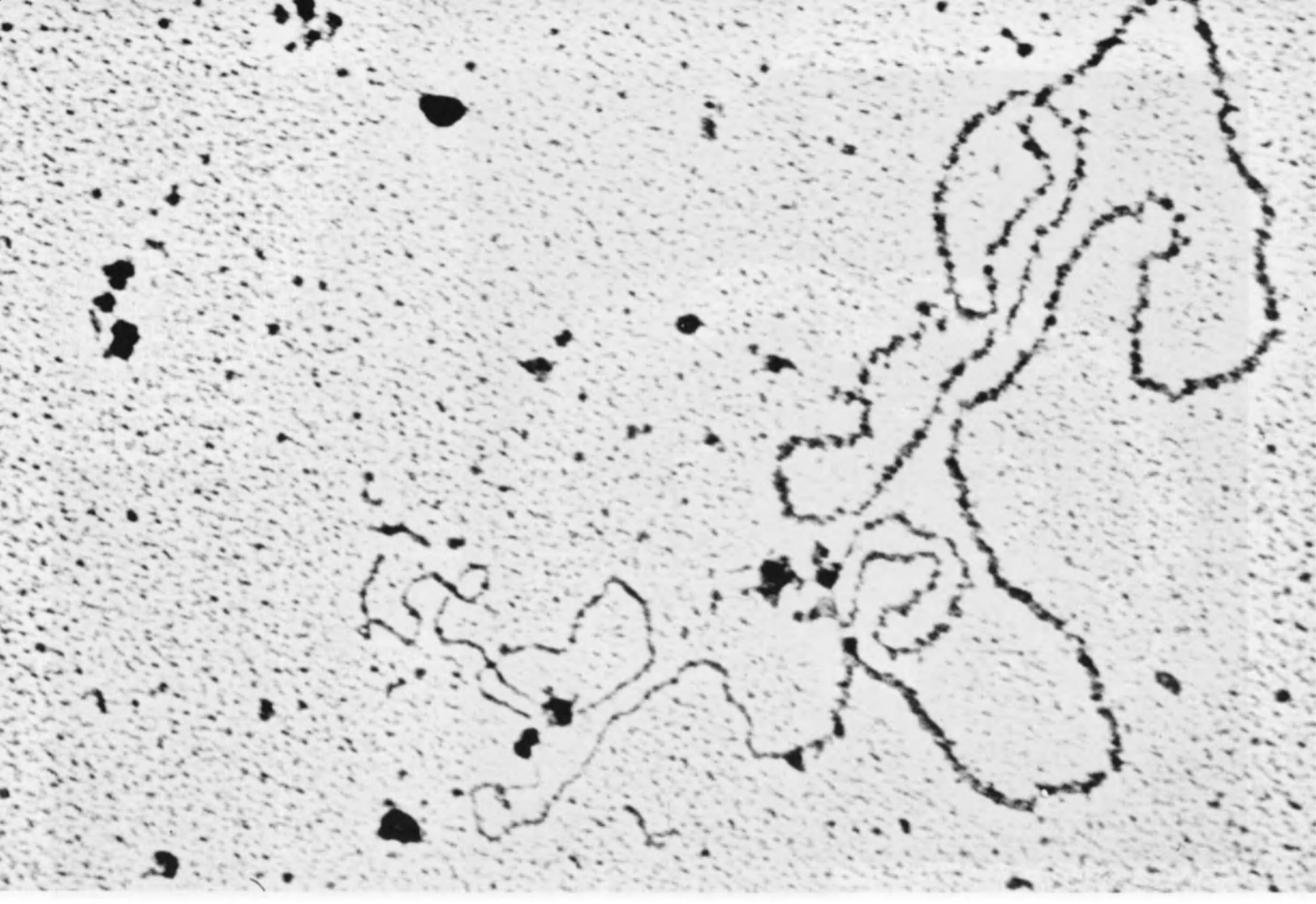

Strand of DNA (deoxyribonucleic acid), the material which carries in coded form the hereditary instructions responsible for the behaviour of cells and the plants, animals or microbes of which they are part.

minants and those of a virus are, in fact, well known.

2. Most of the agents responsible for the occurrence of cancers (viruses, chemical agents, mutations) have this effect by activating or disturbing the normal functioning of certain cellular oncogenes.

3. It has been established that, as a general rule, at least two oncogenes whose effects are complementary must be activated by exogenous influences for a cell to develop a malign condition. This "co-operative" action, which can be experimentally reproduced by manipulating cell cultures *in vitro,* clearly demonstrates the multifactorial nature of cancers.

4. Since the disturbance of cellular oncogenes can result in the appearance of extremely varied cancers, that is to say of manifestations of uncontrolled cell growth, it is reasonable to suppose that, in their normal state, oncogenes play a central, permanent role in the control of the process of cell division and recognition.

In fact, it has been shown these determinants are nothing other than the "genes of communication" between cells. Some of them code for the exogenous chemical signals, the "growth factor" signals involved in this process, others for receptors of these signals located on the cell membrane, and others, finally, for the substances that carry the signal to the chromosomes, once it has reached the receptors, so as to trigger off the cell division. These substances are generally phosphorylation[7] enzymes, or proteins closely related to DNA and capable of performing regulatory functions.

It would seem, therefore, that a general molecular explanation of the development of cancer has been elucidated. Knowledge of the precise phenomena triggered by the activation of oncogenes should make it possible to elaborate new inhibiting products that will block the transformation to cancerous growth and, perhaps, open the way to new therapeutic methods.

The neurosciences

I should like to conclude with a look at the equally fascinating field of neurobiology. No one would deny that, within the highly organized framework of a human being, two "master elements" account for most of our characteristics—our genes and our neurons. Furthermore, the nature of the dialogue between our genes and our neurons is a central problem of biology.

I shall not spend too much time on the formidable arsenal of equipment that has enabled us to overcome obstacles to the study of the human brain: gas encephalography, arteriography and, above all, tomographic densitometry, nuclear magnetic resonance imagery and positron cameras (see the *Unesco Courier,* August 1987). Mention should also be made of the enormous progress made in microscopic observation of neurons.

Yet here again, two fundamental branches of modern molecular biology—immunology with monoclonal antibodies and, above all, genetic engineering—have undoubtedly been responsible for speeding up study of the neuron. Today, most of the proteins and important neuropeptides have been cloned. The genetic probes thus obtained have enabled us not only to analyse the biosynthetic activities of single neurons with extraordinary precision, but also to determine the molecular structure of adjustors[8] and, better still, of receptors and ion pathways.

Without going so far as to suggest that the brain secretes thought in the way that the liver secretes bile, it must be admitted that discoveries concerning the detailed biochemistry of neurons is having important repercussions on pharmacotherapy. It is, however, too early yet to say whether the enthusiasm of the reductionists in this regard is exaggerated or not. The psychophysiologists[9] think that current notions concerning the molecular biology of the neuron will go the same way as the now demoded micro-electrophysiology[10] vogue. Be this as it may, the new field of molecular neurobiology is now open and has already gathered a rich harvest of information.

We should, however, never forget the pluridisciplinary character of the neurosciences. Without recourse to neuroanatomy, neurophysiology and neurohistology, as well, of course, to the study of neuropathological behaviour and diseases, it would be illusory to hope to understand the memory and the major cognitive functions.

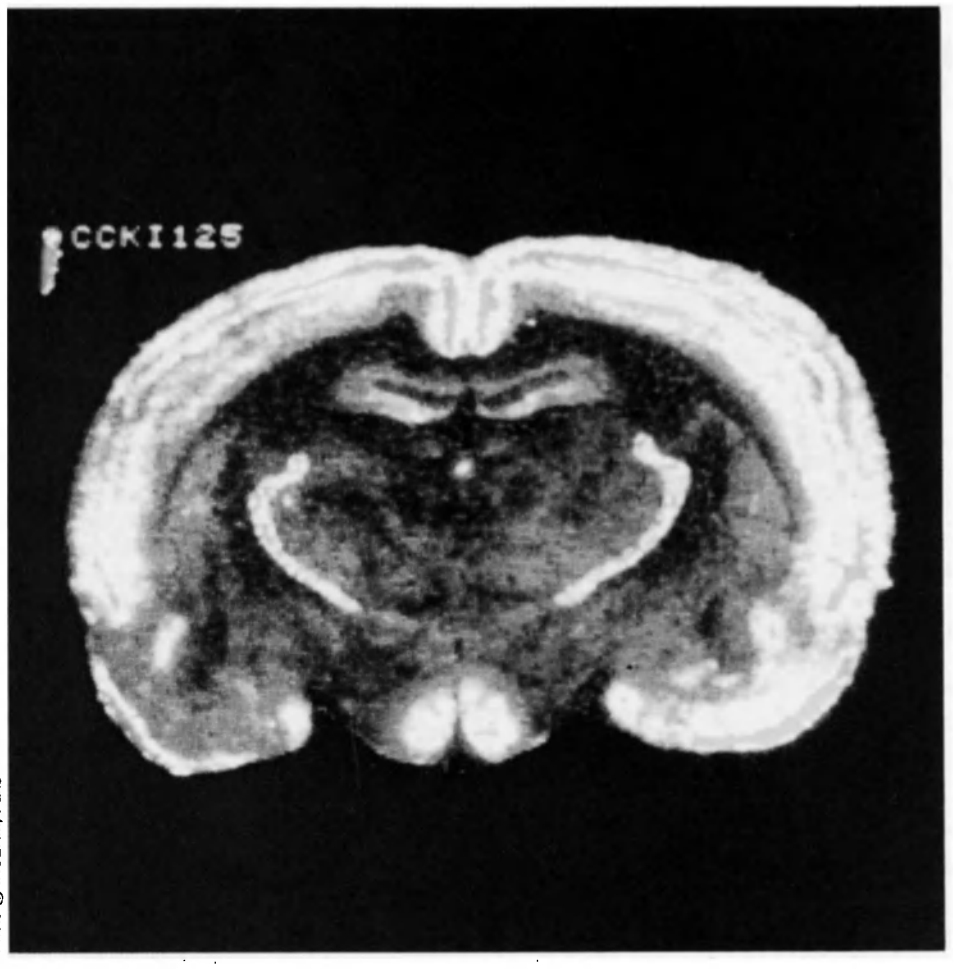

Photo © INSERM, Paris

▲
Autoradiogram of a section from the brain of a rat, on which the location of cholecystokinin (a neurohormone) can be detected with the aid of radioactive tracers.

The study of the genetics of behaviour is also in full ferment. It is true that it throws light only on simple stereotypes, such as the song of the cricket, the reproduction of the aplysia, a marine mollusc, or the short-term learning cycle of the drosophila fly and its memorization. It is also true that we are only at the very beginning of the study of neurogenetic diseases. We can, however, sense the prospect of a modern neurogenetic discipline emerging which is as worrying in its ethical implications as it is full of hope for the medical science of tomorrow.

This exposé of mine has left unexplained many aspects of a biological science "in the making", as well as of a "ready made" biology. I have not explored the vast domain of biotechnological applications; nor have I dealt with the new patterns of pharmaco-medicine, a glimpse of which we have been given with the creation, by the techniques of genetic engineering, of molecules endowed with new therapeutic properties.

I have not touched upon the enormous field of microbic genetics, nor on the molecular revolution that plant biology, long left on the sidelines of contemporary scientific advance, is currently undergoing. Thanks to genetic engineering the elaboration of a physical plant gene map can now be envisaged. Micropropagation techniques,[11] the use of artificial seeding and plant or microbial transgenation[12] could well revolutionize agricultural technology. There is a distinct probability that the next millennium will witness great achievements in plant genetics, the repercussions of which, whether good or bad, will certainly be considerable for agriculture.

For reasons which can easily be imagined, any self-respecting science, and not only biology (which is only one among many sciences), evolves to the rhythm of a kind of "self-induced" acceleration. But in a certain manner biology touches us more closely than the others. As Immanuel Kant wrote concerning biology: "I see in it a disposition of feeling that is very favourable to morality and which, at least, prepares us for it." And did not Louis Pasteur see in biology a kind of panacea, generator of blessings and of peace, intrinsically endowed, as Kant noted, with moralizing virtue? Can such judgements still be upheld? Are they not, as the French doctor and biologist François Jacob pondered, just a little old-fashioned and outmoded? Is it possible to maintain such a vision of the life sciences despite certain obvious deviations, past, present and to come, of the concepts and techniques that have emerged from them, such as the excesses of Nazi researchers and doctors, the threat of the imposition of a "copyright" on human genes, and the menace that will loom over the natural resources of the developing world when micropropagation and genetic engineering have standardized everything?

Yet biology, like all the other sciences, will continue to progress, to surprise, to question. It will continue to bring solutions and replies to our hopes and our questionings. To be more vigilant, more conscious of the limitations and dangers of science, should not prevent us from moving forward. Who could seriously consider turning back the clock of knowledge? Who could be so mad as to outlaw the search for knowledge? We must be more knowledgeable about the results of science, and at the same time be wiser and more humane.

We are about to embark on a great adventure of the mind. Let us hope that it will also be an adventure of reason and of the heart. ■

Brainstem neurons photographed with the aid of an electron microscope
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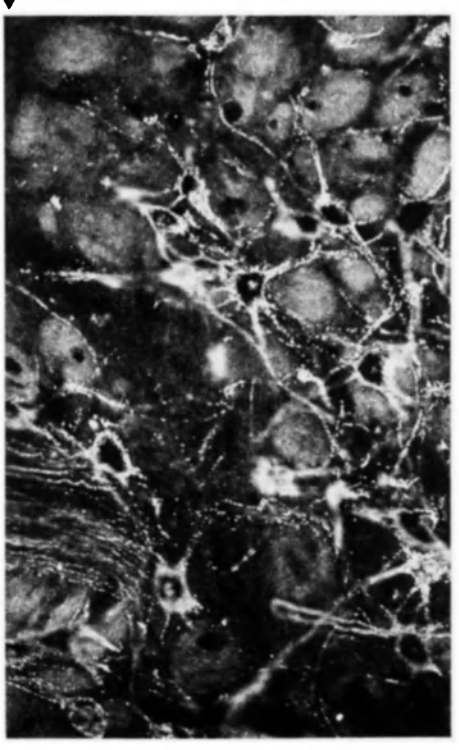

Photo J.P. Gueritaud © INSERM, Paris

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1. Recombinant DNA: The hybrid DNA produced by joining together *in vitro* pieces of DNA from different organisms.
2. Cloning: Asexual reproduction of genetically identical cells or organisms from a common ancestor.
3. Restriction enzymes: a group of proteins produced by living cells which act as natural catalysts by means of which a gene can be excised from a fragment of DNA and grafted on to the DNA of another organism.
4. Monogenic: Relating to or controlled by a single gene.
5. Karyotype: The sum of the specific characteristics of the chromosomes of a cell.
6. Determinant: One of the chemical groupings that together determine the specific reactivity of an antigen or antibody.
7. Phosphorylation: Conversion by enzymes of carbohydrates into their phosphoric compounds.
8. Adjustor: A unit of the nervous system which controls or adjusts stimuli received by a **receptor** neuron before passing it on for action by a motor neuron.
9. Psychophysiology: A branch of psychology that deals with the effects of physiological processes on mental life.
10. Electrophysiology: The branch of physiology concerned with the electric phenomena associated with living bodies and involved in their functional activity.
11. Micropropagation: Multiple reproduction of plants by *in vitro* culture of plant tissue.
12. Transgenation: Gene mutation.

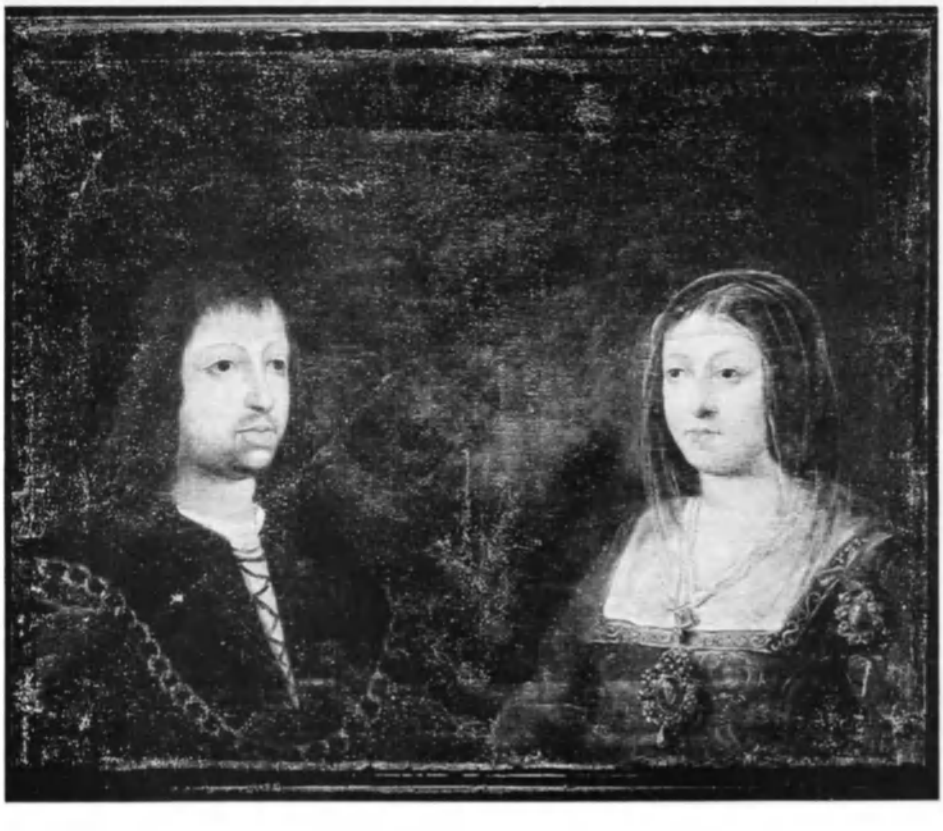
FRANÇOIS GROS, *French biologist, is professor of cellular biochemistry at the Collège de France and head of the biochemistry unit in the Pasteur Institute's department of molecular biology, where his main field of research is the functioning and regulatory mechanisms of genes. His many publications include* Les secrets du gène *(1986). This text was presented at a conference held at Unesco Headquarters in October 1987.*

A New World

... and a new era in world history

by Arturo Uslar Pietri

In 1992 the fifth centenary of an event that had an enormous influence on the history of the modern world will be commemorated, notably in the Spanish- and Portuguese-speaking countries: the arrival of Christopher Columbus and his Spanish crew, on 12 October 1492, in a land which would later be named "America". On that day a far-reaching process of cultural cross-fertilization was set in motion, which, although marked by the violence of conquest and colonization, was to create a new reality, justly called the "New World", that would radically transform the whole planet. The* Unesco Courier *will be devoting more space to this theme in later issues; meanwhile we publish an evocation of that new world by the Venezuelan writer Arturo Uslar Pietri.



Photos Archives Oronoz © Artephot, Paris

IN less than five years' time, day will break on 12 October 1992. The Earth will come into view as the Sun progressively casts its light on a succession of regions, climates and peoples until the planet has come full circle. This is what, symbolically, has happened in the course of five centuries since that day when, with the first light, a new age dawned in the life of man.

It all began with the most auspicious of voyages: three sailing ships, with their eighty-eight crew members and a man of vision who, without knowing it, was trailing the destiny of the world behind him. Their initial reaction was one of mild surprise, but the Europeans soon came to realize that new lands and new peoples had been discovered. They did not know the extent of what they had found, and even today it is an effort for us to grasp the full significance and magnitude of the event. Some considerable time was to elapse before they perceived that they were dealing with a new continent that had never been known in Europe before. Christopher Columbus, the "admiral of the ocean sea", thought that he had found the western route to the Indies; he was searching for Asia and was carrying letters for Prester John, the legendary ruler of the East.

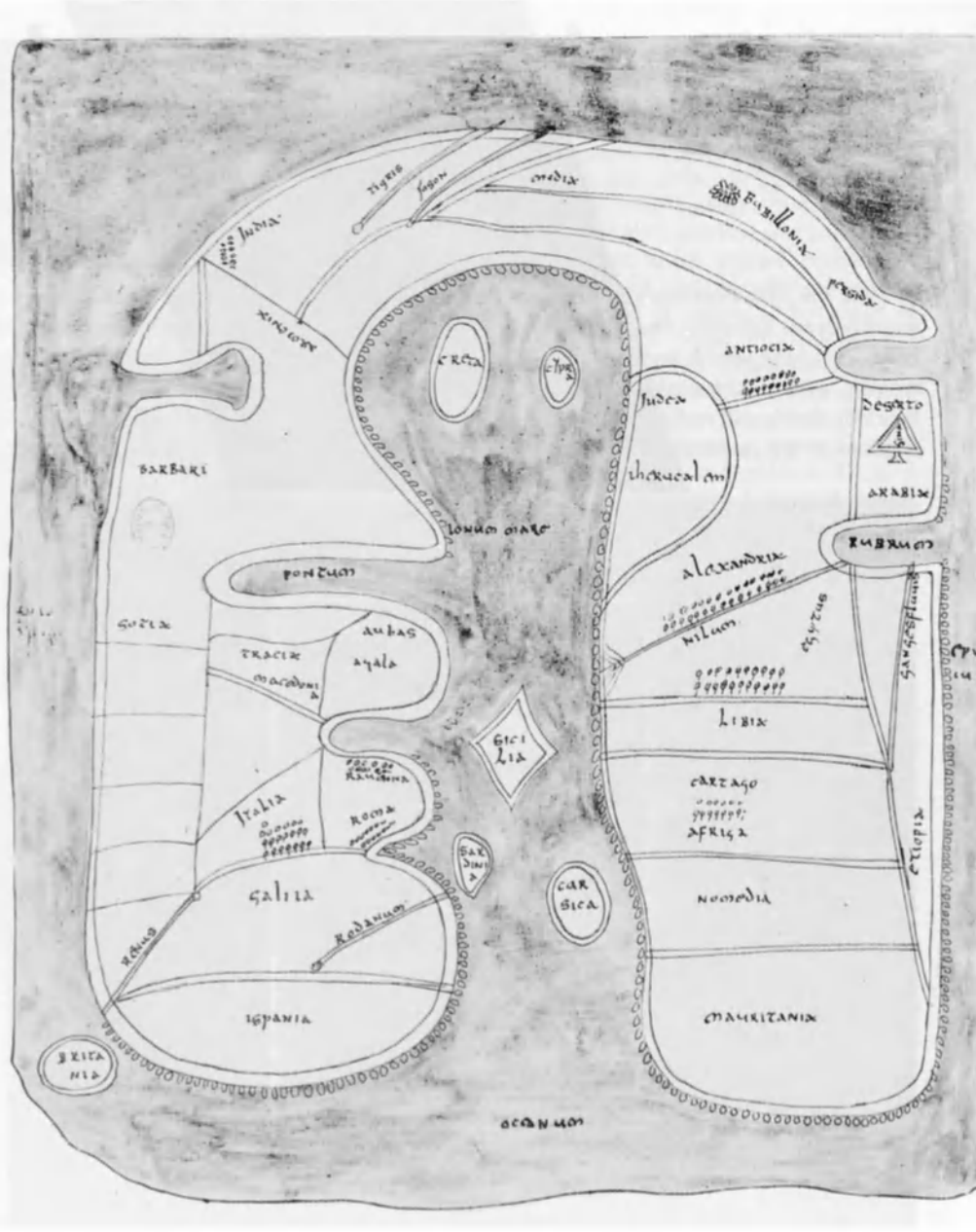
When we speak of the discovery of the Americas, we think of the first fleeting impression which it conjured up in the minds of the Europeans. What actually happened—and this came to be realized as one surprise followed another—was that a new age had begun. The things that Europeans saw or thought they saw, the things they sought and found, the things that were coming to an end or were only just beginning, all represented a new age for mankind as a whole.

◀ **In the great enterprise which led to the European arrival in the Americas—or the Indies, as the land was known at first—the leading roles were played by the Catholic rulers of Spain, Ferdinand II and Isabella I, and the Genoese navigator Christopher Columbus. In 1492 they reached an agreement (the Capitulation of Santa Fé) whereby Columbus's proposals were accepted and it was agreed to fund his voyage. Portrait of Ferdinand and Isabella, left, is today preserved in the Augustinian Convent of Madrigal de las Altas Torres, the queen's birthplace. Columbus's portrait, above, can be seen in the Museum of the Americas, Madrid.**

The news of the discovery spread like a revelation: it stimulated people's imaginations and gave the humanists grounds for rediscovering the remote myths of classical Antiquity. No document had more influence on the turn taken by the European mind than the letter written by Columbus recording the birth of a new era. The immeasurable magnitude of the discovery was unfurled step by step—from the Antilles, with their mythological name, it ranged over the Costa Firme (or mainland), the Darién isthmus, the marvel of the Pacific seaboard, the conquest of Mexico and Peru, the search for El Dorada, the circumnavigation of the globe, and the control of the two immense seas surrounding the new and prodigious land.

It took a long time to learn what the Europeans had found, if indeed we have ever really succeeded in learning: it may have been the Earthly Paradise, the long-lost Golden Age of Greek mythology; or it may have been the Amazons they were looking for on the world's largest river and on the vast sun-lit coast which they called California.

What they above all discovered was the boundless possibilities of the imagination. There emerged from the writings of Columbus, Amerigo Vespucci and Pedro Mártir de Anglería not only the promise of an inexhaustible source of novelty but an irresistible invitation to engage in intellectual creation. In the end, it was to prove possible to find everything that people had ever dreamt of: from the Garden of Eden to the headless men; from the lost tribes of Israel to the imaginary city of Manoa, resplendent with gold and precious stones; from hallucinogenic plants to the Fount of Eternal Youth.



▲ **When Europeans discovered the New World, their ideas on geography changed dramatically and "a comprehensive view of the planet was obtained for the first time". The cosmography of the 2nd century-AD Greek astronomer, mathematician and geographer Ptolemy collapsed, and the centre of the world was shifted from the Mediterranean to the Atlantic. Above, 8th-century map of the world, from a manuscript preserved in a library at Albi (France), follows the ingenuous Ptolemaic conception of the Earth. Right, more realistic 16th-century map of South America from a portolan (medieval navigational chart) by the Spanish cartographer Juan Martínez. ▶**

◀ **On 12 October 1492, Christopher Columbus and his companions disembarked onto American soil for the first time, at the island of Guanahaní (today San Salvador, the Bahamas). This highly imaginative portrayal of the scene was executed by the Flemish engraver Théodore de Bry (1528-1598).**

The Old World meets the New

That day marked the start of a new mutation of the Western world. The great culture which had slowly evolved and spread from the Mediterranean to the Baltic and was steeped in the fertile mix composed of the Greek, Latin and Judeo-Christian heritages, took a giant stride to the far shore of the *mare tenebrosum,* in order to embark on a new stage in its immense creative movement. The Iberians in South America and the Anglo-Saxons in the North, together with the Spaniards, Englishmen, Frenchmen, Dutchmen and Danes who converged on the open space of the Caribbean and turned it into a strange *mare nostrum,* all brought with them an image of Europe that was to change its appearance and significance. In the North, the narrowly circumscribed transplantation of the Puritan colonies was to predominate, whereas in the South there was an unrestricted and mutually rewarding coming-together of different heritages and cultures.

The very same line that had divided the Old World into two spheres of Christianity, with differing conceptions of man and his destiny, was carried over to the other hemisphere, complete with the differences and conflicts emerging from European history between the Protestant North and the Catholic South, between a pragmatic conception of life dedicated to work, thrift and peace-loving virtues and another conception, dazzled by the call of heroism, the tragic and adventurous sense of life, and contempt for passive servility. In the North, they went patiently about their work, sowing the seeds from which Montreal, Ottawa, New York, Chicago and Los Angeles would one day spring. In the South, cities, kingdoms, universities, palaces and convents were to be created in an open-minded attitude to the mixing of cultures, from which a new form of community was to emerge.

What came into being was not so much a new Spain or a new Portugal as a new dimension of the historical estate in a new setting and with different protagonists. At the beginning of the eighteenth century, the New World was that which had been formed in Ibero-America, with which Europe was not very familiar and which it did not readily understand. It was a new society situated not only on one shore of the common sea, but on both shores. It was a community that was to transform the common heritage and to have an influence on its component parts on either side of the Atlantic. The day the King of Portugal set up his court in Rio de Janeiro, it became quite clear that such a community existed, that it did not have a privileged focal point, and that it was consistent with a new age. Had it been possible to carry out the plan put forward by the Count of Aranda,[1] or some such similar plan, the traumatic rift of independence would not have occurred and the powerful affirmation of the Ibero-American community would not have been retarded for more than a century.

The community was created by a growing pattern of exchanges and mutual influence between its two component parts, ranging from mental attitudes and legal systems to customs, diet, the economy, society and the concept of identity.

The Earth becomes one

Had the voyage merely involved the discovery of new lands and peoples, it would not have had such enormous consequences. Many irrevocable changes took place at that "watershed" date, which was also the starting-point for many other changes that are still taking place today. The time when mankind lived separate existences came to an end and a comprehensive view of the planet was obtained for the first time. The cosmography of Ptolemy collapsed; the *mare tenebrosum* became a highway; the centre of the world was shifted from the Mediterranean to the Atlantic; the entire globe was covered by sea routes; and the Earth became one. It has frequently been said that this represented the beginning of a new era in world history, but it is necessary to go further, for with the active merging of four continents and the major oceans, history itself took on a universal dimension.

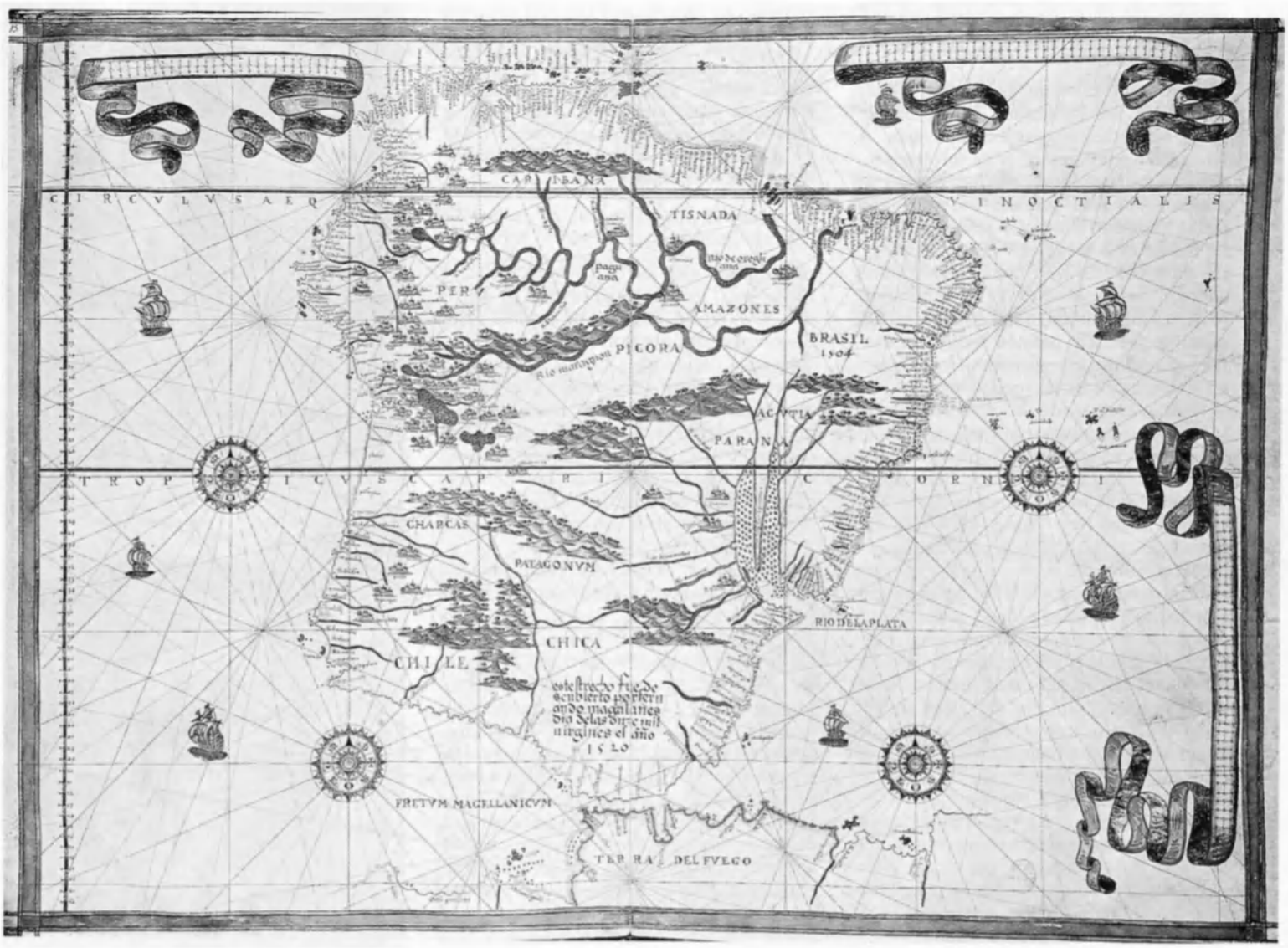


Photo © Artephot, Paris. Biblioteca Nacional, Madrid

People came from every imaginable place, attracted by the promise of the immense discovery. The historian Gonzalo Fernández de Oviedo, who saw them arrive, had this to say: "Here, none of the languages spoken in all those parts of the world where there are Christians are missing, whether it be Italy, Germany, Scotland or England, or whether they be Frenchmen, Hungarians, Poles, Greeks, Portuguese or all the other peoples of Asia, Africa and Europe."

Not only were the great European powers stirred into action in order to exploit the new opportunities, but trade also started with the Chinese ports across the Pacific, in the bid to extend the dialogue between civilizations. Africa, isolated as it was and with no means of taking action on its own, suffered harshly from the discovery. In the space of one century, millions of Africans, bringing their cultural background with them, were to be transported and unjustly put to work performing the basic tasks required to create a new reality.

It was at this time, in fact, that the New World began to steer a new course, not only in the narrow sense used by the humanists of the period, but also in two other real and creative senses that were complementary to one another. There was certainly a New World of the Americas which took shape in a centuries-long development involving the taking-over of the land, the existence side by side of peoples and cultures, the mixing of races and mental attitudes, and the adaptation to new places and new partners in dialogue.

From that moment onwards, neither Europeans, nor Indians nor Africans could go on being the same as they had been. A far-reaching process of cross-fertilization, especially of a cultural nature, was set in motion. The end product was not—and could not be—European, neither could it be Indian or African. To varying degrees, the three cultures were combined with one another and blended to create a different pattern which, although still not fully recognized or precisely defined today, was reflected in all the forms assumed by people's lifestyles, attitudes and relationships.

Whenever a world is created there is something of a cataclysm, whether it be the "Big Bang" of modern astrophysics or the global revolutions of our time. There was a great deal that was cataclysmic about the creation of the New World, what with the bloody struggles, the violence, the heartbreaking rifts, the unaccustomed circumstances in which people were transplanted and had to adapt, the ordeals of living and dying, and the examples of cruelty and magnanimity. Yet they all contributed to a development lasting less than a century in which people of differing and alien origins came to create a new human scheme of things against the huge and varied backcloth of a new continent.

When Cortés, with blood-curdling conviction, tore down the representations of the Aztec deities from their altars and put the cross and the image of the Virgin Mary in their place, he engaged in an act of the most physical and spiritual violence. His attitude, which we are now reluctant to understand, was one that was to spell out the singular nature of the process by which the New World came to be formed. The discoverers did not come to live side-by-side with the Indians or to superimpose their own system: they came to lay foundations, to replant and to create. The priest and contemporary historian Lucas Fernández de Piedrahita spoke with terrible candour of the unwavering intention to "stamp out the idolatry that has been deeply rooted in the barbarous practices of the natives for so many centuries".

The creation of the New World was indeed cataclysmic and a new human scheme of things was to emerge from it. In less than a century, the Spanish, the Indians and the Africans all became brothers in Christ and the spiritual descendants of Abraham, Moses and the Fathers of the Church. This was to form the main basis for the striking cultural unity which spiritual communion was to impart to this new incarnation born of old and separate cultures. The New World, with all its specific features and nuances, became Christian and part of Western culture, which would define its identity and destiny for ever more. Thus was formed the life-enhancing clay from which "the Inca" Garcilaso de la Vega,

Photo Archives Oronoz © Artephot, Paris

▲ **Bartolomé de las Casas, the "Defender of the Indians", as depicted in a painting preserved in the Columbus Library, Seville. The great Spanish historian and polemicist was the first to force a major expansionist power, as Spain was in his day, to reflect on the wisdom of its conquest and subjugation of peoples, in the name of a universal vision of humanity.**

Photo © A. Muñoz de Pablos, Paris

The Amazon forest, Venezuela. The grandiose and mysterious landscape of the New World formed a powerful stimulus to the European mind and imagination, fuelling the spirit that impelled so many explorers to go in search of the Amazons, El Dorado or the Fount of Eternal Youth. ▶

Simón Bolívar, Benito Juárez and Rubén Darío were to spring.

Far-reaching transformations

The date of 12 October 1492 marked not only the beginning of a New World in the Americas, but also that of the most far-reaching change ever experienced by the rest of the planet in its entire history. The historians of science, thought, economics and society have all stressed the immensity of these new developments. The avalanche of precious metals from the Americas, for example, was behind the rise of capitalism and present-day monetary systems, in that the thousands of tons of gold and silver shipped back went beyond the confines of medieval-style banking transactions and created a transnational financial market.

Population growth in Europe, which was instrumental in bringing about major urban concentrations, national consolidation and the subsequent development of the industrial revolution, had its roots not only in worldwide market expansion but also in the fact that the famines which had decimated the Europeans for centuries had finally come to an end. The role played in this development by some of the non-human factors arising out of their discovery of the Americas, such as maize and potatoes, was decisive. Eating habits and social practices alike were transformed by the introduction of tobacco, cocoa, rubber, quinine and Brazilwood. The red macaw and the plumed Indian featuring in the multi-coloured decors of the baroque painters are a spectacular manifestation of this definitive presence.

The novel concept of the Americas and all that it implied was to change the science and thinking of the West. In their view of the planet and the cosmos, people had to abandon Ptolemy's ingenuous cosmological mechanism in favour of the heliocentric conception of the planetary system, with all its far-reaching consequences. The new climates, the new skies, the reality of the Antipodes, the inexhaustible variety of plant and animal life never seen before, were all to give rise to doubts and debate and to lead to further questions, such as whether those animals had not been known in Noah's Ark and, if they had, how they had come to disappear from the Old World.

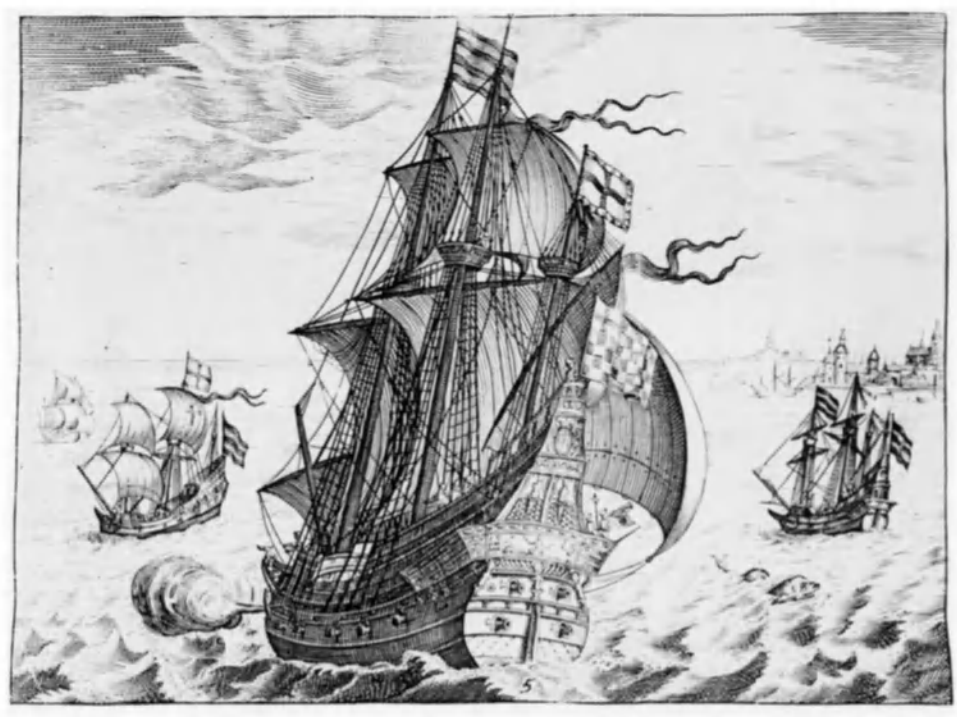
The advances made in science in the nineteenth century have their roots in the Americas. The book by Acosta,[2] Alexander von Humboldt's travels, and the arrival of the *Beagle*—the boat on which Charles Darwin made his celebrated voyage—off the coast of South America and the Galapagos, were all key background material for Darwin's formulation of the doctrine on the origin of species.

'Utopia is American'

The ideas of independence and revolution that have dominated the history of the modern world have their origin in the experience of the Americas. Utopia is American. Columbus's letter and the publications of the first chroniclers of the discovery were to come as a shock to European thought. The devastating impact of that scarcely understood revelation can be seen in the essays of Michel de Montaigne.

Thomas More's famous book *Utopia* (1516) is plainly the ideological consequence of this first view of the American world. More, the Chancellor-saint, looked with disgust on the England of his time. Poverty, injustice, war, hatred and power struggles had only served to spread misfortune everywhere. His main character, Raphael Hythloday, confirmed what Columbus and Vespucci had already announced, namely that there was another world

For centuries, Spanish galleons (below, 16th-century engraving) would ship back the gold and silver of the New World to Europe. This avalanche of precious metals had a decisive influence on mercantile expansion and the development of capitalism, on which the modern industrial economy is founded.
▼



where people lived in peace, plenty, justice and honesty. The conclusion was inevitable: the Europeans had in many ways departed from the true path and had been condemned to live in an abominable form of society.

In this connection, some years ago Paul Hazard, the historian of ideas, spoke authoritatively of the crisis of European consciousness, which is nothing but the harrowing and painful reflection on their own situation inspired in Renaissance thinkers by the vision of the "noble savage". This fundamental contradiction between what exists and what is possible was to feed the revolutionary thinking which culminated in the Enlightenment with Jean-Jacques Rousseau and the Encyclopaedists and with the great and bloody baptismal rite of the French Revolution. In this sense, Robespierre, Marx, Lenin and Mao can be said to have followed earlier thinking on the discovery of the Americas.

There has been an overwhelming tendency to look upon the history of political ideas from the European standpoint. Yet it was on American soil that the idea of independence was raised for the first time and that reference was first made in a fundamental historical document [Declaration of Independence, 1776] to the self-evident truths: "... that all men are created equal, that they are endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness". It was likewise on American soil, in the Preamble to the world's first written Constitution—that of the United States of America—that there first appeared a figure whose unwonted presence was asserted by a phrase that was subsequently to echo as far as the furthest corners of the Earth: "We the people ... ".

There is nothing that exists today by way of civilization, politics or thought that is not a consequence, in some way or another, of the great event which had Columbus's voyage as its point of departure, whether it concerns the arts or the sciences, ideologies or customs, or the concept of the universe and the concept of mankind itself.

If the discovery is confined to only one of its aspects, or if it is simplified into only one of the infinite number of facets which it has continually displayed over half a millennium, then it is condemned not to be understood. If it is reduced to the elementary idea of a discovery and conquest, then it will be mutilated and deformed until it becomes unrecognizable. There can be no denying that there was a discovery in a fleeting and piecemeal fashion, and that there was also a conquest, with all its terrifying inhuman—or perhaps only too human—consequences. But this was only part, albeit a necessary and inevitable part, of an immense process that has no parallel in history.

Matters of conscience

There was a bloody stage of conquest, and that word alone conjures up frightful images in the memories of peoples, especially among the weakest. However, while it was unfortunately not the first time, nor the last, that one nation has imposed itself by force on others, it was, outstandingly, the one exemplary occasion in history when a conquering power stopped in its tracks to give thought to the legitimacy and justice of what it was doing.

The debate that took place in Valladolid in 1550 and the royal edicts stemming therefrom[3] represented the first occasion on which a major power called a halt to its expansion in order to resolve the issues of justice and conscience entailed by that fact. It was on that occasion that a proclamation was made for the first time from the highest level of the State, to the effect that "all peoples are nations" (Bartolomé de las Casas), that all nations have rights that have to be respected, and that they form an international community. What was no less important was the fact that because they were men, those remote and unknown Indians had the same rights as the conquistadors. Is there any human being on Earth today who would be prepared to disavow and reject this heritage?

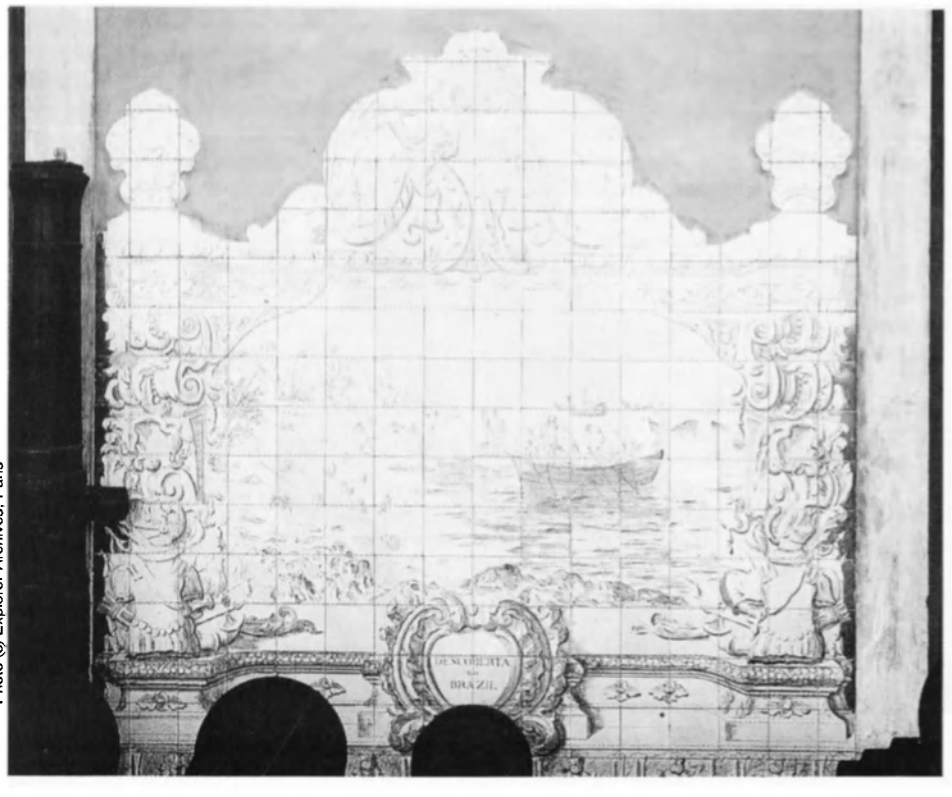
Mankind as a whole should be convened to commemorate with proper dignity the fifth centenary of that symbolic date and all its implications, without exception and without confining it to only one of its aspects.

By the time 12 October 1992 comes, the enlightened words verging on blasphemy which the cleric and historian Las Casas wrote to the Emperor Charles V may not sound so much like hyperbole: "The best thing since the creation of the world, other than the incarnation and death of Him who created it, is the discovery of the Indies, which is why they are called the New World." ■

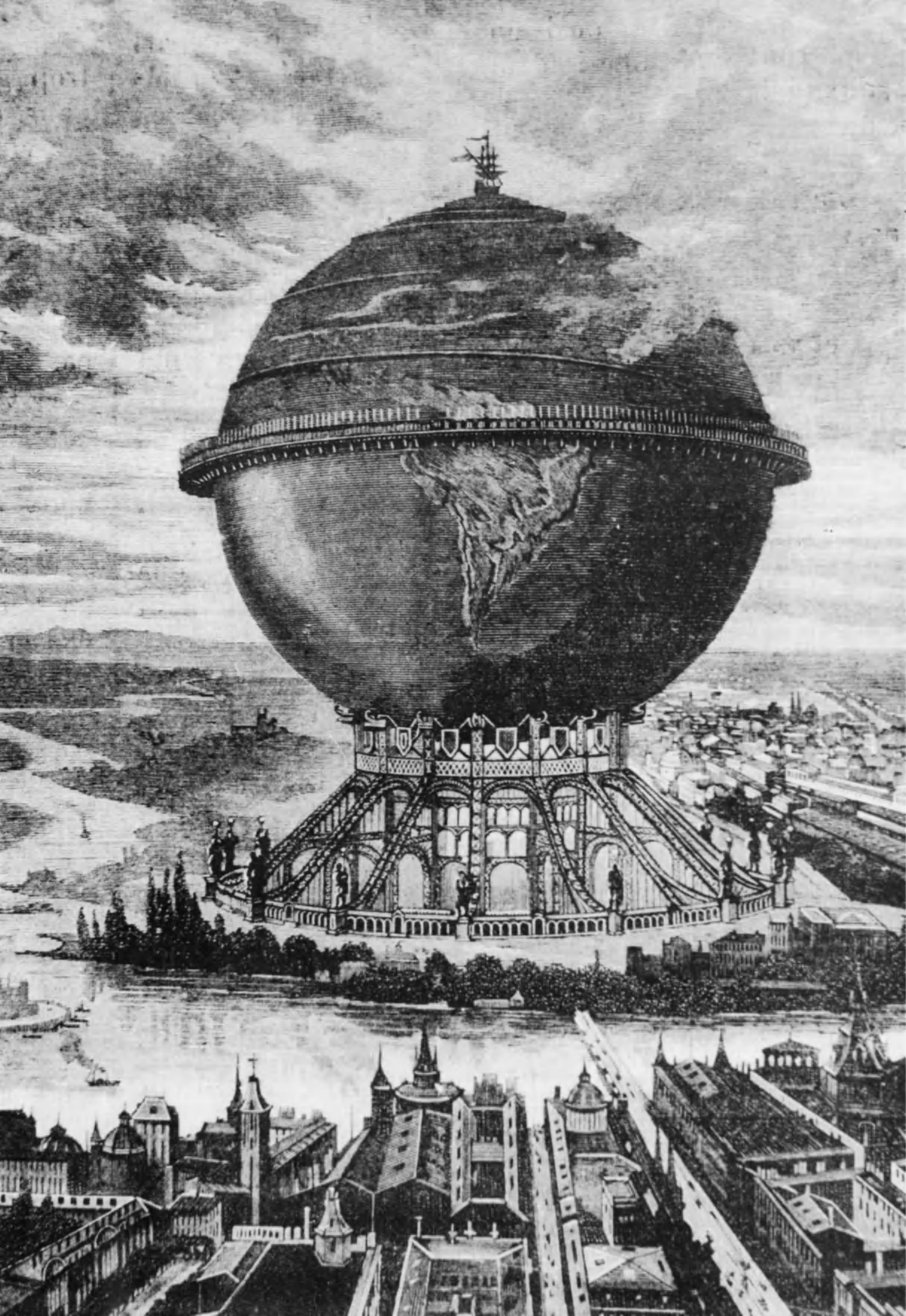
It was on the soil of the New World that the ▶ first modern democratic Constitution was drafted, that of the United States of America. Its effects were wide-ranging and profound. Right, contemporary engraving of the monument to Christopher Columbus at the Chicago Exposition of 1892.

1. At the end of the eighteenth century, this reform-minded Spanish governor proposed that three vassal but self-governing kingdoms—Mexico, Peru and Tierra Firme—be created in Spanish America, with only Cuba, Puerto Rico and some points of the mainland continuing to be colonies.
2. *Historia natural y moral de las Indias* (1590; *Natural and Moral History of the Indies*, 1604), the earliest survey of the New World and its relation to the Old, by the Spanish theologian, missionary and historian José de Acosta.
3. In 1550 the Emperor Charles V convoked a meeting of theologians, the Council of Valladolid, to discuss the questions raised by the anti-colonial writings of Las Casas. One of the most positive outcomes of the debate was a revised version of the "Laws of the Indies". This legislation, extremely liberal for its day and intended to protect the American Indians from colonial excesses, was not always enforced in practice. *Editor.*

ARTURO USLAR PIETRI, *Venezuelan writer and politician, taught Latin-American literature at Columbia University, United States, before serving as his country's ambassador to Unesco and as a member of the Organization's Executive Board. His wide range of published works includes the historical novels* El camino de el dorado *(1947) and* Oficio de difuntos *(1974); the short story collections* Red *(1936) and* Pasos y pasajeros *(1965); and essays among which are* La otra América *(1974),* Fantasmas de dos mundos *(1979) and* Giotto y compañia *(1987).*



◀ **In 1500, eight years after Columbus landed in the Bahamas, a major breakthrough occurred in the exploration of the South American continent. The Portuguese navigator Pedro Alvares Cabral reached the coast of what is today Brazil. Left, Portuguese *azulejos* (painted and glazed tiles) show Cabral rowing ashore.**



San Francisco de Lima

A jewel of Latin American baroque art

by Christina Barbin

WHEN the arts of Latin America are discussed outside the continent, the first thing that springs to mind, for both specialists and the general public, is the exceptional pre-Columbian legacy. Colonial art, both sacred and profane, was long considered a provincial outgrowth of the manneristic and baroque art of the Old World, and attitudes towards it have been very slow in changing. Yet this period produced important works in architecture, sculpture, painting and gold and silver work, of which the Convent of San Francisco de Lima is one of the most outstanding examples.

In 1535, the Emperor Charles V ordered the conquistador Francisco Pizarro to earmark two sites in the urban plan of Lima then under preparation, to be used by the Franciscans to erect their church and convent. Situated right in the centre of Lima on the banks of the River Rimac, these lots (with later additions) formed the largest area ever to have been occupied by a convent in the New World: one eighth of the area of the colonial city which had 14,000 inhabitants at the beginning of the seventeenth century. On 4 February 1656, an earthquake destroyed a major part of the church and convent. The Portuguese architect Constantino de Vasconcellos, who lived in Lima, was entrusted with the task of rebuilding the complex, generally known as the Convent of San Francisco, which now comprises the churches of San Francisco, La Soledad and El Milagro, with their cloisters, patios and outbuildings.

The problem facing Vasconcellos was how to erect a monumental church able to withstand earthquakes. His solution was twofold. On the one hand, he built a barrel vault resting on solid pillars, a technique which allowed for the construction of tall and resistant structures. On the other hand, the building materials he used were wood and a mixture that the conquistadors had borrowed from the Indians: *quincha,* a conglomerate of rushes, mud and plaster. Both light and relatively elastic, *quincha* is considered to be an earthquake-resistant material, and was later to be used for a whole series of buildings along the coast of Peru, for which San Francisco was the model. Thanks to these building methods, the complex has survived the earthquakes of three centuries.

While the profuse ornamentation of the Convent of San Francisco is clearly inspired by European art, in the Spanish *mudejar,* manneristic and baroque styles, the materials are an original response to local conditions. With the exception of the "altarpiece-portal" and the lateral portal, both of stone, the whole church, including the towers, some 35 metres in height, are made of *quincha.* This makes the whole complex look like a giant clay sculpture.

The most talented artists of the day—goldsmiths, silversmiths, sculptors, painters and wood carvers—contributed to the ornamentation. A factory was even set up to produce painted and glazed tiles *(azulejos)* to decorate the outbuildings. San Francisco thus became a sort of college of arts and crafts. After the death of Vasconcellos, his disciple, Manuel de Escobar, from Lima, completed the work in 1672. It is to him we owe the beautiful lateral portal.

As in the case of most baroque churches in Spanish America and in contrast to European and Brazilian Baroque, the architectural groundplan of San Francisco is very simple: three 7-span aisles, a transept and a presbytery. Decorative exuberance spills over the facades, altarpieces, domes and towers. Wealth of form makes up for modesty of materials: the church is literally covered in relief decoration.

The two bossed towers flank a stone "altarpiece-portal". It dates from 1664 and is the work of Vasconcellos. Damian Bayon, a Argentine historian, describes it as "stone chiaroscuro proliferation", a lavish but harmonious mass of sculptures, niches, frontispieces, windows and pilasters.

These "altarpiece-portals", typical of Latin American churches, date back to sixteenth-century Spain. The altarpiece is brought forward to the church portal, bringing religion to the street. This was considered essential by the conquistadors, who saw Christianity as a great unifying bond between populations of different origins.

San Francisco was the church attended by the Viceroy of Peru and his Court, and for this reason it received many donations and legacies, generated by the rich Peruvian gold and silver mines. The convent thus accumulated a vast treasure, part of which disappeared in the nineteenth century during the wars of independence. Nevertheless it can boast today some outstanding works of art.

Besides the fifteen canvases of the *Apostolado* (one of only three in the world) painted by the Spanish artist Francisco de Zurbarán and his workshop, there are thirty-nine canvases in the main cloister, painted between 1670 and 1672 by four local artists (Francisco Escobar, Fernando de Noriega, Andrés de Liébana and Diego de Aguilera), representing the life of the founder of the Order; a triptych by Angelino Medoro and a *St. Bonaventura* by the same artist; eleven seventeenth-century Flemish canvases of the school of Rubens; a *Coronation of the Virgin* by Juan Solórzano, a native of Cuzco, and many other paintings of the same school. An exceptional ensemble of Sevillian *azulejos* adorns the main cloister, not to mention all the carvings, furniture, and delicately wrought silver and gold ware. The library deserves special mention. It contains numerous manuscripts and more than 25,000 printed volumes, including fifteenth-century incunabula and many sixteenth-century first editions.

Earthquakes (especially that of 1974), the ravages of time, constant humidity, but also human negligence, have gravely damaged the convent. In 1941, the Government of Peru declared it a national monument and began urgent restoration work. Since 1978, Unesco, in collaboration with the United Nations Development Programme (UNDP), has contributed some 300,000 dollars towards technical assistance, training of restoration experts and equipment.

Some of the consolidation work to be carried out is particularly urgent, but Peru is experiencing a difficult economic situation and cannot meet all the costs involved. To raise the 3 million dollars that are needed, it is essential that the international community rally to the country's aid, as the Director-General of Unesco explained in his appeal launched from Lima on 2 April 1987. It is to be hoped that the response will be generous, as it has been in favour of other major universal works of art which bear witness to past cultures, such as the Borobudur monument or the Nubian temples. The loss of what was the most beautiful ornament of the "city of the kings", today a living testimony to the history of South America, would be irreparable. ■

CHRISTINA BARBIN, *of Argentina, has worked for several years as an editor in Unesco's Office of Public Information. She has published a number of articles on cultural themes in the information bulletins of different countries, and is the author of a monograph (1986) on the Colombian painter Omar Rayo.*

***Saint Bartholomew,* from the atelier of Francisco de Zurbarán (1598-1664). The canvas forms part of a series of fifteen in the Convent of San Francisco de Lima. Restoration work on these paintings was carried out in 1987 as part of a vast endeavour to save the convent undertaken by the Government of Peru with the aid of Unesco, the United Nations Development Programme (UNDP) and other organizations.** ▶

Photo Unesco

Photo C. Errath © Explorer, Paris

▲ **The complex known as the Convent of San Francisco consists of three churches, with their cloisters, patios and outbuildings. Above, façade and main portal of the church of San Francisco.**

The Portuguese architect Constantino de Vasconcellos, who was commissioned to rebuild the Convent of San Francisco in the mid-17th century after an earthquake had largely destroyed it, searched for a light and flexible form of construction that would withstand earth tremors. He hit on the idea of using as building materials wood and *quincha,* a conglomerate of rushes, mud and plaster traditionally used by the Indians, instead of stone or brick. This unusual and economical technique met with great success, and is being revived today in the restoration of certain parts of the convent buildings. ◀

Photo Unesco

The interior of the convent is profusely decorated. Below, detail of the magnificent panelled ceiling of the main cloister, which has been seriously damaged by the ravages of time, humidity and insects. ▼

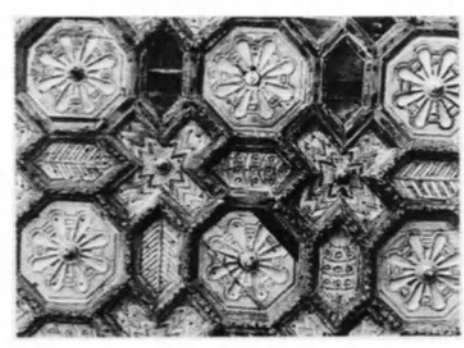
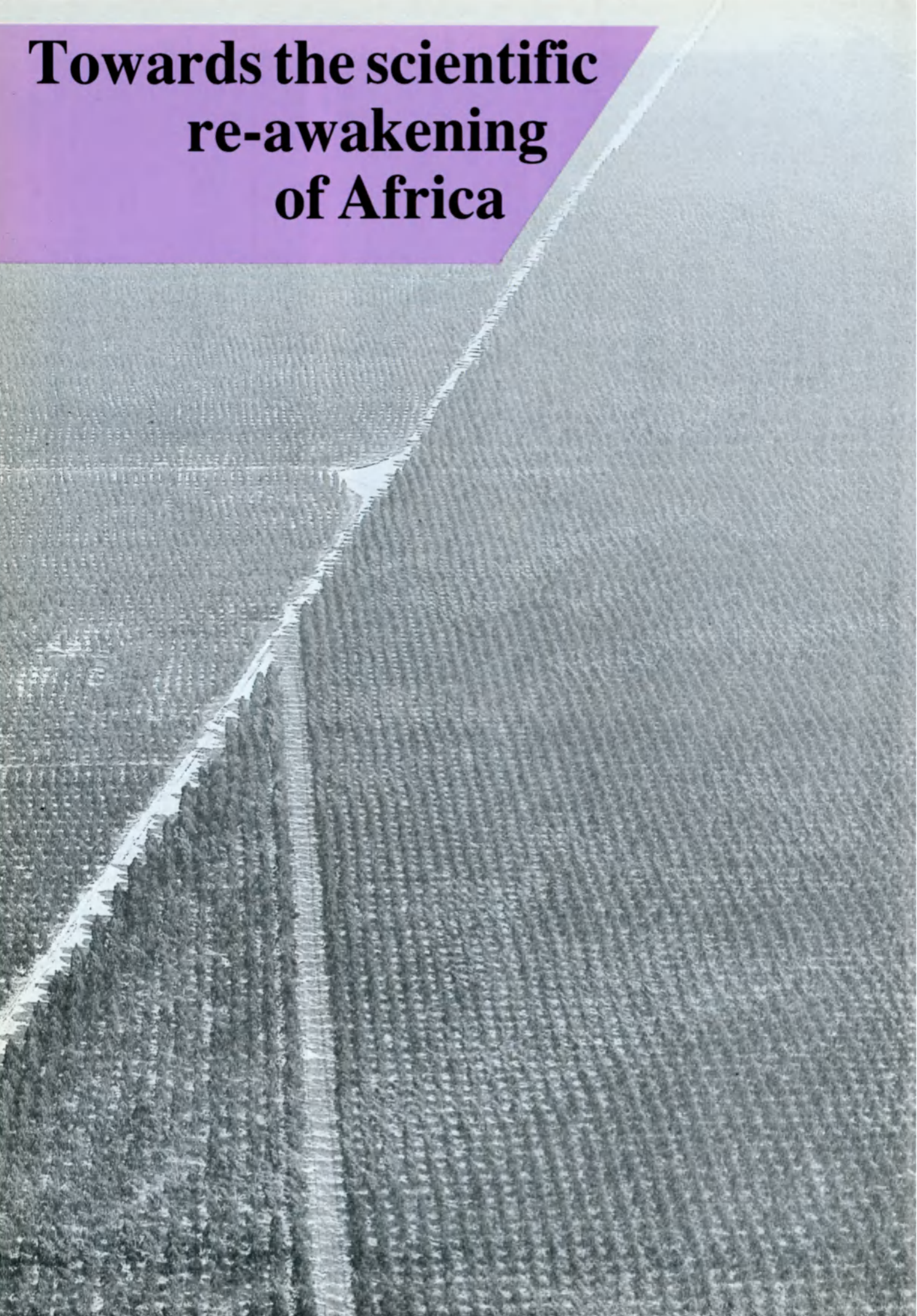


Photo Unesco

Towards the scientific re-awakening of Africa



Dependence that is detrimental to progress

Africa is going through a development crisis "influenced by the emergence of new problems of exceptional gravity. ... It is becoming increasingly difficult to maintain broad sectors of the population above subsistence level. ... The food and health situation is becoming more and more precarious. Infant mortality is rising. In ecological terms, Africa's environment is deteriorating." This is the alarming opening statement of "The Kilimanjaro Declaration", adopted on 15 July 1987 by the Second Conference of Ministers Responsible for the Application of Science and Technology to Development in Africa (CASTAFRICA II), organized by Unesco in Arusha, United Republic of Tanzania. How can this situation be rectified? "The only way to improve the standards of living of the peoples of Africa", the Declaration goes on, "is to take practical action to develop their scientific and technological capabilities in a spirit of unity and solidarity." In June 1987 a First Congress of African Scientists, convened by the Organization of African Unity (OAU) in Brazzaville (Congo), was attended by eminent scientists from Africa and from other regions of the world. These initiatives underline the fact that Africa's prime strategic objective is to reduce its dependence in the field of science and technology, and to develop its immense economic, social and cultural potential. Published on the following pages are extracts from two documents submitted to CASTAFRICA II: the first, from the OAU, outlines the science and technology situation in Africa today; and the second, from Unesco, is concerned with the development problems of the African continent.

AFTER two decades of independence enjoyed by the majority of African States, it is apparent that, despite the efforts of governments and populations, they "are not yet in control of the phenomena associated with the development of the contemporary world, the conceptual systems and the general conditions governing life on earth that will most strongly affect their future", in the words of Alioune Diop, Senegalese founder of the Présence Africaine publishing company in Paris. None of the States has acquired the basic minimum of scientific and technological know-how needed to bring about the required economic breakthrough.

It is clear that by dint of having looked to the outside and having organized itself in terms of and for the benefit of the outside world, Africa is now in a situation of economic and technical dependence. Admittedly, the concept of technical dependence has many meanings which range from mutual trust to subordination. Where there is mutual trust we can only be glad: such a situation engenders prosperity and develops scientific co-operation. In the latter case, however, dependence is based on a unilateral and asymmetrical relationship, in which one party, Africa, is unfortunately in a markedly inferior position.

In the meantime, new disciplines are developing in the industrialized countries, such as genetic engineering, robotics, microcomputing, remote-sensing, photo-electric and aerospace technology and microbiology. The developed countries continue to lead the world in all these fields. Ninety-five per cent of all research and development takes place in these countries. The consequences of this state of affairs are unimaginably far-reaching.

What is Africa's place in this changing situation? Admittedly, some progress has been made in the past few years. The reports *National Science Policies in Africa* and *Survey on the Scientific and Technical Potential of the Countries of Africa,* submitted by Unesco in 1974 to the First Conference of Ministers Responsible for the Application of Science and Technology to Development in Africa (CASTAFRICA I), reveal that at the time Africa had nearly 700 research institutions employing more than 6,000 full-time researchers, 5,000 part-time researchers and some 20,000 technicians. In all, approximately 30,000 people were engaged in research and experimental development.

Discoveries made in the field of biology in Africa are already influencing medicine and food production to a considerable extent. In Cameroon, the establishment of an industrial unit for manufacturing medicines was one of the results of the research carried out on the medicinal properties of the *Pentadiplandra brazzeana* plant family. Dr. Thomas Wandji, author of this research, acknowledges that "given the efficacy and considerable originality of the *brazzeana,* medicines based on these substances might well create a considerable stir all over the world". Our geneticists are endeavouring to improve our natural, animal and vegetable resources and are studying ecosystems and pollution problems. Our governments have allocated substantial funds to cover running costs and investments, despite the difficult economic climate.

Funding research

Nevertheless, Africa is still a consumer of science and technology and its lack of progress in several areas is a cause of concern. Fewer than ten African States are close to the target set by the United Nations with regard to the training of researchers, namely 230 research workers to every million inhabitants. In 1980, Egypt had 500, Ghana 474, Tunisia 560, Senegal 240, Kenya 160, Côte d'Ivoire 155 and the Libyan Arab Jamahiriya 103. In some cases, up to 60 per cent of them were foreigners. In 1974, out of a total of 2,978,204 scientists and engineers worldwide, 94.1 per cent were working in the industrialized countries, 5.8 per cent in the developing countries and 0.1 per cent in the least developed countries. Of the 12,000 researchers in Africa, only 9 per cent work in research, and 55 per cent in higher education.

The financing of research also calls for a number of comments. In 1978, the average per capita expenditure on research and development was 2.75 dollars in the developing countries (0.38 per cent of GNP), as against 147 dollars in the Organization for Economic Co-operation and Development (OECD) countries (2 per cent of GNP) and 186 dollars (2.8 per cent of GNP) in the East European countries.

Many African States do not have a separate item for research in their budget. However, the international conference held in Lagos (Nigeria) in 1964 recommended that approximately 0.5 per cent of GNP be allocated to research and development and that this amount be periodically

◀ **Despite Africa's serious scientific and technological deficit, in certain sectors the most advanced techniques are in use. Pharmaceuticals are being manufactured as a result of research carried out on the medicinal properties of the *brazzeana* plant family in Cameroon, and in the Kouilou region of the Congo, genetic engineering techniques for the cloning of plants are used in the laboratory to create selected varieties of eucalyptus, which are later cultivated in plantations (left).**

Photo Jean Guy Jules © A.N.A., Paris

Photo G. Boutin © Hoa-Qui, Paris

At the Pasteur Institute, Bangui (Central African Republic), an offshoot of the research centre in Paris, African researchers study colon bacilli responsible for diarrhoeal diseases in children.

reassessed. At present, Côte d'Ivoire allocates to R&D 0.6 per cent of its GNP. In 1978, Senegal spent 33 per cent of its budget on education, training and culture and 1.2 per cent of its GNP on scientific and technical research. In Tunisia, the funds spent on research are already equivalent to more than 3 per cent of the government's revenue. Elsewhere, the rate varies between 0.1 per cent and 0.3 per cent.

With regard to scientific information and documentation and extension work, there is no lack of impediments. In *Science and the Factors of Inequality*, a collective work published by Unesco in 1979, Ahmad Y. al-Hassan, Rector of the University of Aleppo (Syrian Arab Republic), asserts that in the Arab and Muslim countries only six university libraries have more than 200,000 volumes each. Researchers are obliged to travel around " ... to those distant lands where knowledge is developed", according to the Beninese philosopher Paulin Hountondji. At a symposium organized in Yaoundé (Cameroon) in 1980 by the African Intellectual Property Organization (OAPI), it was pointed out that a great many exploitable patents covering African products were gathering dust in files: technical information does not circulate properly, nor, alas, is it used to good effect.

Shortage of equipment and personnel

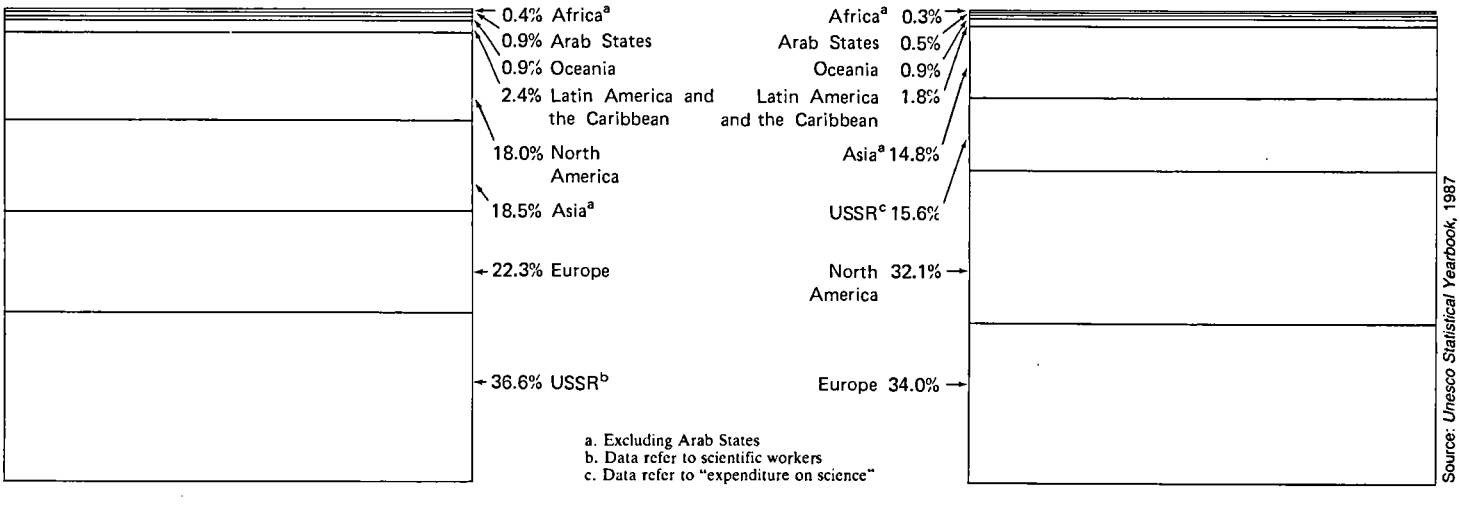
The field of computer technology makes an interesting case study. In Africa the supply of equipment was initially uncoordinated. Subsequently the situation improved considerably, especially in Algeria and Tunisia. However, the proportion of GNP devoted to computer technology in these two countries is still small.

In 1979, according to a survey by the United Nations Economic Commission for Africa (ECA) in 144 African institutions, the number of computers was as follows: 99 in North Africa, 29 in West Africa, 25 in Central Africa, and 104 in East Africa—a total of 257. The implementation of Africa's Priority Programme for Economic Recovery (1986-1990) calls for the effective and widespread use of computer technology.

The "brain drain" of trained scientists and technicians is another serious problem. The reasons for this are well known: unsatisfactory working conditions and research facilities, low salaries, lack of career prospects, and the low esteem in which researchers are held. Many qualified candidates, facing the prospect of unemployment, no access to facilities and information or personal fulfilment, either move to the industrialized countries, or accept administrative posts in which their university training and their skills are put to very little use. Between 1962 and 1967, 70,000 trained professionals from developing countries settled in the United States. Each year, 10,000 intellectuals leave the Arab countries for countries with high technological and industrial potential. This phenomenon has been referred to as "transfer of technology in reverse". It is estimated that between 1960 and 1972 the underdeveloped countries trained some 227,000 specialists for three industrialized countries: the United States, the United Kingdom and Canada.

Science is becoming increasingly costly, with the result that the

Distribution of scientists and engineers, and expenditure by groups of countries on research and development (R&D), 1980



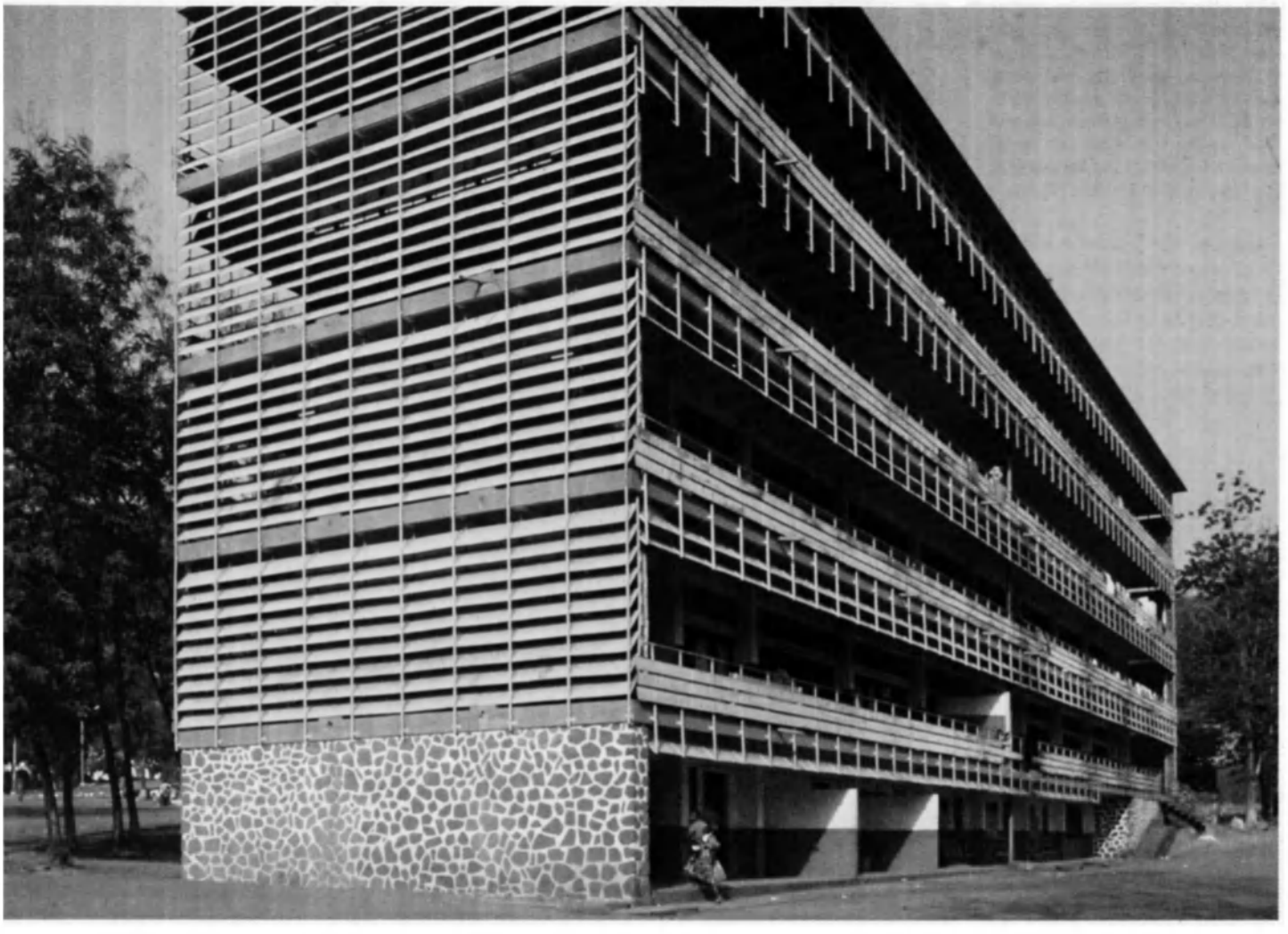


Photo G. Boutin © Hoa-Qui, Paris

Photo M. & A. Kirtley © A.N.A., Paris

▲ **Medical science is highly developed in Africa, particularly some of its most advanced techniques. Left, open-heart surgery in Treichville, a suburb of Abidjan (Côte d'Ivoire); above, Bangui General Hospital (Central African Republic).** ◀

African States are finding it very difficult to finance research and the requisite facilities. For example, in order to develop computer technology in the Congo, the seventy-five projects adopted will require approximately 2,600 months of planning and nearly 29,000 hours of tests over five years, and will cost approximately 1,400 million CFA francs. Moreover, there is a shortage of computer personnel.

The technology gap

The problems of development have sparked off a great debate in Africa. If this debate is confined to Africa's slow technological progress, the following points emerge:

- the lack of "political will" to organize and promote scientific development; this is often apparent in the absence of science policy;
- society's low regard for researchers; the absence in most cases of a statute defining their status in the national public service; the intolerance shown towards them, which must be seen as one of the causes of the brain drain; the lack of dialogue between scientists and government, which creates blockages detrimental to the development of science in Africa;
- the fact that the content of, and present trends in, science and technology in Africa still depend very largely on external needs and interests, particularly those of multinational companies.

History repeatedly shows that no country has developed significantly without a basic minimum of research, science and technology. In the changing socio-economic pattern of the modern world, scientific advances and technological inventions have made an immense contribution to the development of the productive forces, which have brought improvements to people's working and living conditions. Tremendous progress was made throughout Europe, North America, Japan, Australia, New Zealand and even in some countries that were in the process of industrialization, so that many Africans are now amazed at the scientific progress and technological achievements of those coun-

Photo M. Huet © Hoa-Qui, Paris

Although "enrolment in higher education has increased eightfold since 1960", seven African countries still have no university. Moreover, too few students are graduating in scientific and technical subjects, and there is a shortage of suitable equipment and qualified teachers. Right, the University of Ibadan, Nigeria.

tries, forgetting that these great innovations, far from being fortuitous, are simply the result of human beings' determination to master the environment in which they live by giving full rein to their natural curiosity and creativeness.

In its present state, Africa must develop or perish. It can no longer allow millions of its children to languish and vegetate in insanitary hovels, threatened by every affliction, while it possesses vast potential waiting to be developed.

Despite the problems which assail it from every side, Africa cannot sacrifice its future to short-term requirements. The prime strategic objective in the field of science and technology must be to reduce its absolute dependence. There are several reasons for doing so: firstly, economic reasons. African States are sinking deeper into debt every day and are constantly increasing the deficit of their balance of payments. The lack of skilled manpower and servicing possibilities add greatly to the cost of maintaining imported equipment, and foreign technical assistance is not cheap.

One consequence of this dependence is, of course, the power that it gives to countries exporting science and technology to determine the policy of underdeveloped countries. For example, they can erect strong protectionist barriers against those countries, which may also be forced to purchase machines and other goods exclusively from one specific supplier. Many African governments lack the institutional and technical resources which would enable them to make an informed choice between the different technologies available to them. They are often subjected to commercial and political pressure so that immediate concerns take precedence over long-term provisions.

Towards self-reliance

Will Africans have a place in the world of the year 2000? Whether we take the year 2000 or the year 2050, we can achieve a better future only if we create the components from which it will be built, and create them now. A number of major changes is essential.

In July 1979, the Heads of State and Government of the Organization of African Unity (OAU) meeting in Monrovia made a commitment to "put science and technology in the service of development by reinforcing the autonomous capacity of our countries in this field". Science and technology are among the sectors which are given a prime position in Africa's Priority Programme for Economic Recovery (1986-1990). The Lagos Plan of Action (1980-2000) called on African States to invest sufficient resources in the promotion of science and technology.

How can this be achieved? Two approaches are possible. One would be to induce Africans to create at all costs, to reinstate, develop, promote and make systematic use of their own endogenous scientific and technological knowledge. The other approach would seek to master the use of scientific and technological knowledge from outside Africa and to assimilate it.

The first approach in isolation would lead to autarchy, which would be fatal, for in order to progress, science needs inputs from home and abroad. The second approach would lead to mimicry, the harmful consequences of which are well known. The ideal middle course would take account of the need to remain rooted in one's home ground while becoming receptive to the outside world. According to the Lagos Plan of Action "Africa must cultivate the virtue of self-reliance. This is not to say that the continent should totally cut itself off from outside contributions. However, these outside contributions should only supplement our own efforts".

Science and technology function most effectively when fed by contributions from home and abroad. For that reason, Recommendation 4 of CASTAFRICA I (1974) emphasized the need for each country to establish appropriate machinery to be responsible for the elaboration of a national science policy and capable of promoting genuine research for development and encouraging a spirit of creativity and innovation.

A strategy for success

Success comparable to that enjoyed by Japan since the Meiji period is possible in Africa, but it is held in check or even thwarted by a number of obstacles. The internal consolidation of nations which are often disparate, as a result of frontiers imposed by the colonial powers, seems to have led to overdue emphasis being given to the political aspects of every problem, in the sense that winning and keeping power take precedence over technical efficiency. This is compounded by the almost universal indifference shown towards scientists and cultural figures. These negative factors have all been responsible for poor results: the insignificance of research centres and the absence or inconsistency of policies for culture and science.

The fact must be recognized that modern research requires a developed productive base which we Africans do not yet possess. Research in our States, at present, is essentially colonial in character and outward-oriented, an inheritance from the past. It is not directed towards satisfying the essential needs of the peoples of Africa. The products of our research centres are not for our own consumption; these centres are still concerned with improving the quality and the profitability of products for export. Research topics, funding, staff, almost everything comes from abroad, and in some cases returns there.

In order to remedy this situation our States must decisively redirect research towards satisfying not only material but also cultural objectives. Pure and applied research must seek to increase self-sufficiency in all areas, and to mobilize all material and human resources for development.

All such goals are conceivable if the political will exists at the highest level to develop a science and technology policy worthy of the name and to establish planned objectives and a strategy for achieving them. ■

Photo Guy Le Querrec © Magnum, Paris

The development crisis in Africa

Africa possesses enormous mineral wealth, including 30 per cent of all known uranium reserves, as well as vast rivers with the potential to supply around a quarter of the world's hydro-electric power. Below, the Arlit uranium mine in north-western Niger.

▼

EVERYONE agrees that the present development crisis in Africa is alarming. Yet it is not due to a shortage of human or natural resources. In addition to the enormous potential of its young population (46 per cent under the age of 15), this second largest continent after Asia, with an area of 30.3 million km^2, still has 800 million hectares of potentially arable land (although only 170 million were cultivated in 1985). Africa's share of world mineral reserves is 96 per cent for diamonds, 90 per cent for chromium, 85 per cent for platinum, 50 per cent for cobalt, 55 per cent for manganese, 40 per cent for bauxite, 13 per cent for copper, 50 per cent for phosphates and almost as much for gold, and 30 per cent for thorium and uranium; it also has large deposits of nickel, lead and iron.

Moreover, the continent's huge energy potential is as yet virtually untapped: to date only ten African countries are oil producers and although Africa possesses 20 to 27 per cent of the world's hydro-electric potential, it has harnessed only a very small part of it. It is therefore surprising that a continent so well endowed with natural wealth should be in a state of economic stagnation, or even decline.

Should we not seek the cause of the problem in the inadequacy of Africa's scientific and technological capacity? This seems to have been the conclusion reached by the Organization of African Unity (OAU) during the preparation of Africa's Priority Programme for Economic Recovery, in which it is stated that: "Experience indicates that no country has attained any breakthrough in its economic development without a minimum science and technology base."

A divided continent

Development efforts in Africa run up against a great number of difficulties, the major causes of which are the partitioning of the continent, the dependence of the

The traditional, predominantly agricultural, sector of the African economy and the modern, industrial sector exist side by side without the one significantly affecting the other. Below, a supermarket in Abidjan, Côte d'Ivoire. Right, a tent shelters children in the Sahel region, where, because of semi-permanent drought, only a bare minimum of agriculture and livestock raising can be carried out.

Photos M. & A. Kirtley © A.N.A., Paris

economic systems of Africa, unsuitable development policies and strategies, the educational situation and the handicap of illiteracy.

The division into a multitude of small States is the first obvious problem for the peoples of Africa. The natural wealth referred to above is very unevenly distributed among more than fifty States with, at present, over 500 million inhabitants. Ten per cent of them live in countries poorly endowed with natural resources and half of them, spread among thirty-four African States south of the Sahara, live in poorly irrigated or drought-prone areas.

These and many other geographical and linguistic considerations are so many reflections of a fragmentation generating economic, commercial, scientific and technological constraints that are difficult to surmount within territorial boundaries which are usually narrow and often not clearly defined. This can be illustrated by the following statistics: in 1983, 39 African States had fewer than 10 million inhabitants each. These included 12 of the 14 land-locked States of Africa, mostly in the Sahel region, and 12

States with fewer than 1 million inhabitants. Of the 37 countries designated by the United Nations as the "least developed countries" (LDCs), 26 are in Africa; 24 of them are classified as countries which do not produce enough food to support themselves and 21 are on the World Bank's list of low-income countries. The economic development of all these countries would certainly benefit if they belonged to regional co-operation groups or to subregional economic communities.

All the characteristic features of underdevelopment are to be found in African economies. Based essentially on exports of raw materials and mass imports of manufactured goods, these economies are characterized by dependence, a low growth rate of gross domestic product (GDP)—estimated at 1 per cent for the continent as a whole between 1980 and 1984—a huge trade deficit and a heavy foreign debt, representing 43.8 per cent of GDP and 187 per cent of the value of exports and non-factor services* in 1984.

* Not including factor incomes (work and capital).

The limited range of exports makes African economies even more vulnerable. While raw material prices are collapsing on the world market, the manufactured goods imported by African countries to meet their consumer needs are becoming more and more costly, entailing a persistent deterioration in the terms of trade.

As a result, the world economic crisis which has now lasted for over a decade has had a harsher impact on the African economies, leading to an unprecedented social, economic and food supply crisis in Africa. This situation is in fact only the final stage in a process which began long ago, with the introduction of economic structures during the colonial era based on production strategies whose chief objective was the fulfilment of needs external to the African continent.

Economics of dependence

After twenty-five years of independence in the case of most African States, these structures have changed very little, and African economies are still largely dependent. The development policies implemented by African countries themselves have created the following additional inadequacies: limited development of human resources and failure to exploit them properly; extremely inadequate scientific and technological capacity, reflected in low labour and capital productivity; poor organizational and management capabilities of both public and private administrations and enterprises.

In agriculture, the dominant sector in most African economies, development policies and strategies are marred by inadequate investment, lack of incentive measures for farmers, shortcomings in the application of research findings due to the limited development of extension services (especially in the case of food crops), the lack of a pricing policy and the inadequacy of the system for the marketing, distribution, storage and conservation of agricultural produce.

The industrial sector is still undeveloped and heavily dependent on foreign capital. Most companies are established by means of transfers of frequently cumbersome foreign technology that is ill-suited to the economic situation in African countries. As a result, the goods produced by local enterprises are far from competitive.

In 1980, the industrial sector accounted for only 9.8 per cent of the formation of GDP in the region and Africa's share in world production based on value added was only 0.9 per cent, compared with 2.7 per cent in South-East Asia and 6 per cent in Latin America.

Progress in education

A substantial effort has been made in the field of education since the Conference of African States on the Development of Education in Africa, held in Addis Ababa in May 1961, where it was agreed that by 1980 the countries of Africa were to provide free and compulsory primary education for all, secondary education for 23 per cent of schoolchildren having completed primary education, and higher education for at least 2 per cent of students having completed secondary education.

Today, about fifteen African countries have achieved or are in the process of achieving universal primary education. The average enrolment rate in the 6 to 11 age-group for the continent as a whole is 62 per cent and that of secondary education is 20 per cent in the corresponding age-groups. In higher education, enrolment has increased eightfold since 1960 but there are still major disparities from one African country to another. Seven countries (Cape Verde, the Comoros, Djibouti, Equatorial Guinea, the Gambia, Guinea-Bissau, São Tomé and Principe) still have no higher education establishments. As regards adult education, significant progress has been made, the illiteracy rate having dropped from 90 per cent in 1960 to 60 per cent in 1985 for Africa as a whole.

However, Africa is still one of the most disadvantaged regions in

The modern sector of the African economy is often heavily dependent on international markets and foreign capital. Below, futuristic architecture of a bank in Nairobi, Kenya.
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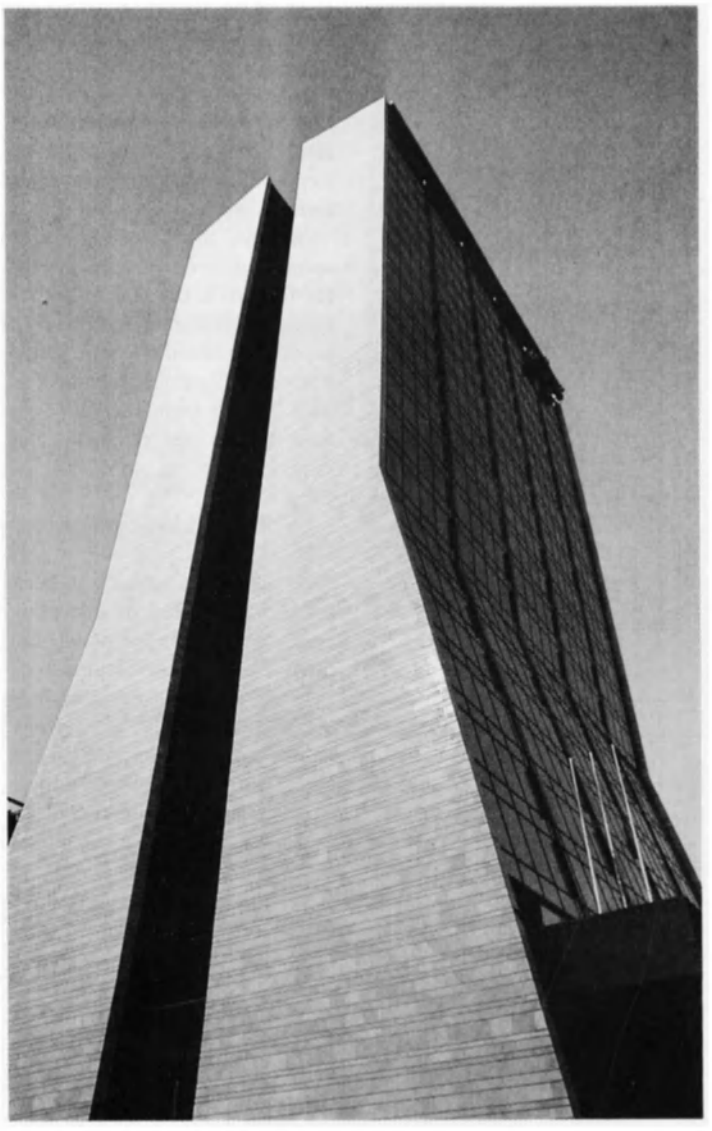

Photo Renaudeau © Hoa-Qui, Paris

educational terms at all levels. Despite the progress made, it is exceptional for even 30 to 40 per cent of children at primary schools to go on to secondary education. In 1980, a total of 29 million African children in the 6 to 11 age-group were not enrolled at school, and 39 million in the 12 to 17 age-group were outside the education system.

Statistics apart, the most worrying aspect of school and university education in Africa remains that of the relevance of its general tendencies and content compared to the needs and objectives of African social and economic development. One of the shortcomings of the existing education systems in African countries is the limited development of technical and vocational education and the scant attention paid to guiding students towards scientific and technical subjects. Science teaching is virtually non-existent in primary education, while in secondary education, where students are first introduced to science and technology, courses lack practical content for want of suitable equipment and qualified teachers.

Science and technology teaching

In higher education, African universities set themselves in 1961 the objective of training 60 per cent of their total student intake in science and technology. In fact, no university has yet consistently reached this objective. According to the partial results of a study undertaken in 1982 by Unesco's Division of Science and Technology Policies for an average of ten countries, the percentage of students enrolled in science and technology courses had risen from 18.76 in 1970 to 28 in 1980.

According to data published by Unesco's Education Sector, the percentage of students enrolled in natural science and engineering courses increased between 1970 and 1980 in 21 of the 37 countries covered by the study. The number of graduates in the three fields as a whole (natural science and engineering, medical science and agricultural science) represented less than half the total number of graduates, with the exception of four African countries: Egypt (50 per cent), Kenya (51 per cent), Swaziland (58 per cent) and Tunisia (53 per cent). In most of the other countries this proportion varied between 20 and 40 per cent.

Generally speaking, the major problem faced by science and technology education in Africa remains the under-equipment of schools and universities and the shortage of qualified teachers. In this respect, it should be stressed that the establishment by Unesco in 1984 of a Regional Advisory Committee on the Renewal of Science and Technology Teaching in Africa and, at the 23rd session of its General Conference in 1985, of a Regional Advisory Committee on Higher Education in Africa, are important contributions to the development of the scientific and technological capabilities of the continent.

■

Photo © *Cahiers du Cinéma*, Paris

"Based essentially on exports of raw materials and mass imports of manufactured goods, African economies are characterized by dependence, a low growth rate of gross domestic product, a huge trade deficit and a heavy foreign debt." Right, a dockside warehouse at San Pédro (Côte d'Ivoire) where coffee is among the main crops exported to the industrialized countries.
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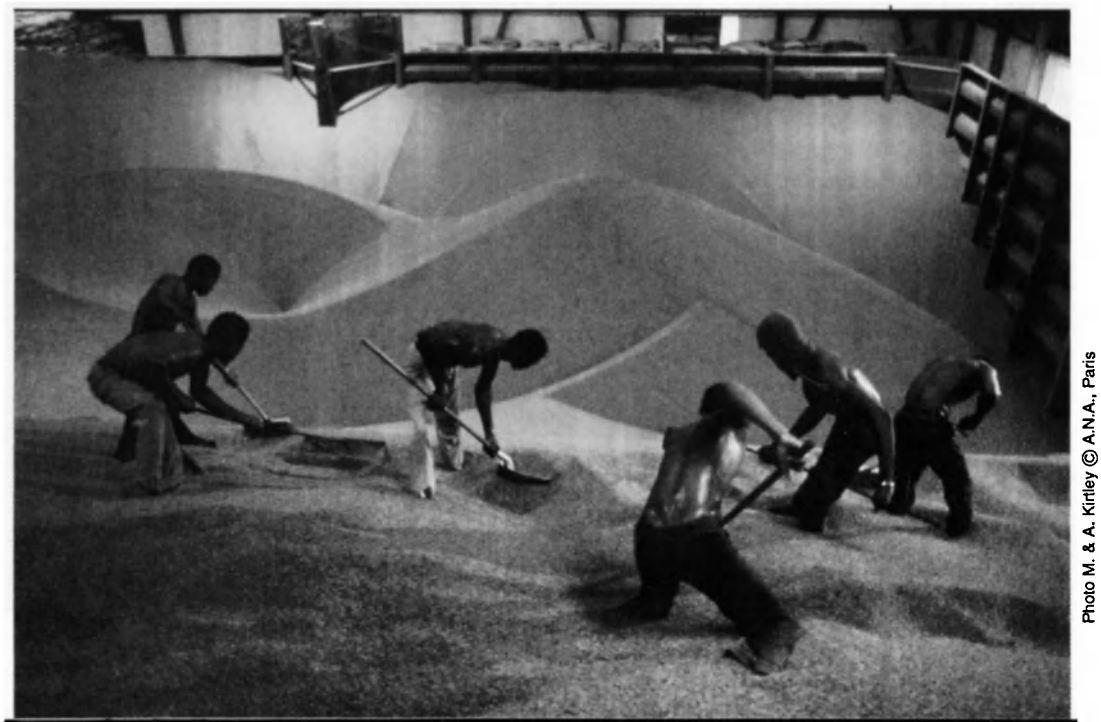

Photo M. & A. Kirtley © A.N.A., Paris

African cinema

A young and relatively unknown art

by Tereza Wagner and Claude Ondobo

ALL African wisdom is to be found in oral culture—in words, speech, symbols and rhythm. So the highest form of artistic expression is story-telling: not merely the narrative as such, but the whole scene of storyteller and audience, with pauses and rhythm and concrete ways of representing the word. There is a strong similarity between African stories and the language of film, and it is not surprising that African cinema, born only thirty years ago, should already have produced some first-rate film-makers and films which rank with the great classics of world cinema.

But although this cinema is important in the eyes of connoisseurs and film buffs, it is still relatively unknown to a wider audience, whether at home or abroad, since it has developed in isolation, virtually without help from the outside world, sure of its inspiration, its strength and its rights. For this very reason, despite the crisis affecting the film world everywhere, African cinema today is indispensable, since its aesthetic, its themes and its symbols are like an influx of new blood. African film-making carries within itself the seeds of a renewal of cinematographic language. Apart from the similarity between the latter and African storytelling, African civilization possesses another feature which links it with the language of film: the fact that the imaginary and the real are placed on an equal footing.

Cinema, which is the art of metaphorical representation of human situations and feelings, has a language of absolutes. It brooks no half-measures and never says anything that does not signify: in this it differs from literature. This makes it an art with a close grip on reality, traditionally an art of entertainment but, besides, an area for reflection on all the social, political and cultural problems which arise in a particular society. In Africa, modernity and tradition seem incompatible, more so than anywhere else. African cinema is striving to find a point of convergence between these two types of society. This is true, above all, of the first generation of African film-makers. African cinema uses the tradition/modernity dichotomy to illustrate political issues as well as cultural and psychological themes.

This opposition between the modern world and the world of the ancestors is a constantly recurring theme in the works of two of the founding fathers of African cinema, Ousmane Sembène, from Senegal, who is also a novelist, and the late Oumarou Ganda, from Niger. The latter began his career as an actor with Jean Rouch, the French film-maker and pioneer of *cinéma-vérité*, a movement which had a profound influence on *cinéma d'auteur*, or

▲ ***Yeelen*** **("The Light", 1987), by the Malian film director Souleymane Cissé, was awarded the Jury Prize at the 1987 Cannes Film Festival. Set in traditional Africa, it is the story of a confrontation between father and son which results in natural disasters as well as economic and social disruption.**

Photo © Cahiers du Cinéma, Paris

The life of African students in Paris is the theme of *Concerto pour un exil* ("Concerto for an Exile", 1968) by Désiré Ecaré, from Côte d'Ivoire, one of the pioneers of African cinema.

Photo © Cahiers du Cinéma, Paris

African cinema, influenced in many cases by the Italian Neorealist movement, has a strong social commitment as well as being an art of entertainment. Right, still from *Mandabi* ("The Money Order", 1968), by the Senegalese film director Ousmane Sembène.

the distinctively personal style of film-directing, in the 1960s.

Ousmane Sembène, aware of the cultural and political role that any creative artist has a duty to assume in society, became a film director the better to attain his chosen objectives. He very quickly realized that, in Africa, films reached a wider audience than literature. His films, like his books, take a shrewd look at the past and present attitudes of the peoples of Africa. With rare courage and lucidity, this man strives through his work to denounce vacillating, cowardly or ineffectual behaviour on the part of those who are motivated by greed for profit and glory, masquerading as religious faith and respect for tradition. Conversely, women and the younger generation are bearers of the hope that some day a fine, strong African society will emerge.

Whereas for Sembène the two cultures, traditional and modern, must blend into a single culture, in order to eliminate both the ignorance behind a blind respect for tradition and the powerlessness that is often engendered by a false concept of modernity, Oumarou Ganda made a painful choice in favour of village life. However, he was well aware that village life cannot remain set apart from economic and cultural developments. His analysis therefore coincides to some extent with that of Ousmane Sembène.

Other pioneers of African cinema are the late Paulin Soumanou Vieyra, from Senegal, and the Ivorians Timité Bassori and Désiré Ecaré, all three trained in Paris; Ruy Guerra, from Mozambique, who worked mainly in Brazil; and the self-taught Mustapha Alassane, from Niger, to mention only the best known.

The first full-length African feature film, *La Noire de ...("Black Girl")*, was made in 1966 by Ousmane Sembène. Based on a minor news item, this film traces the reasons which induce a young Senegalese domestic servant, working for some former *coopérants* (French Peace Corps workers) who have settled in Antibes, to commit suicide. The film's symbolism is powerful, and in some respects recalls the tragedy of the slave trade. African film-makers are aware of the weight of their history and the disasters of submission, and until the late 1970s they used films on mythological, fictional and documentary subjects, and also cartoons, as a means of describing all aspects of what it is to be African: in everyday life *(Borom sarret*—"The Building Site"—a short film made in 1962 by Ousmane Sembène), in relations with the West *(F.V.V.A.*, 1972, by Mustapha Alassane), in dreams and weaknesses *(Le wazzon polygame*, a medium-length film made in 1971 by Oumarou Ganda), and in the battle for freedom *(Soleil O*, 1969, by Med Hondo).

Between 1975 and 1980, some very interesting film-makers joined the ranks of the pioneers: the Malian Souleymane Cissé, trained, like Sembène, in the USSR; the marvellous Gaston Kaboré from Burkina Faso, trained in Paris; the Senegalese Djibil Diop, director of only one full-length feature film, *Touki-Bouki*, but which is regarded as one of the most important products of the national film industry; Safi Faye, the first African woman to distinguish herself as a talented film-maker, Johnson Traoré, trained in Paris; the Guinean Moussa Kemoko Diakité, trained in the Federal Republic of Germany; the Gabonese Pierre Marie Dong and Philippe Mory, both trained in France; the Congolese Sébastien Kamba, also trained in France; the Cameroonian Daniel Kamwa and the Mauritanian Med Hondo, already mentioned, both of whom came to the cinema from the theatre; and, lastly, the film director, novelist, playwright and producer, the Nigerian Ola Balogun, also trained in Paris. This second generation of film-makers won international recognition for African cinema.

The historical film emerged in Africa in the 1980s, addressing new themes which do not necessarily stem from the modernity/tradition dichotomy. This is true, for example, of the very fine full-length films of Gaston Kaboré, including *Wend Kuuni* ("The Gift of God", 1982), and that of Souleymane Cissé, *Yeelen* ("The Light", 1987), which won the Jury Prize at the 1987 Cannes Festival. *Wend Kuuni* is a psychological drama which tells the story of a child who is abandoned by his family and becomes autistic. But this inner silence cannot remain impervious to the warmth of fellowship emanating from the community. *Yeelen* is a dramatic work in which a father's jealousy of his son, who is to be initiated into sacred knowledge, locks the two in mortal combat. The action of these two films unfolds in traditional societies where the conflict between tradition and modernity is no longer used as a frame of reference.

If the historical film is proving more and more attractive to African film-makers, it is because this type of subject affords an opportunity to describe the religious, political and social order of rural communities and to show their

Photo © *Cahiers du Cinéma*, Paris

Still from *Soleil O* ("Sun O", 1969), by the Mauritanian film-maker Med Hondo. The struggle for freedom under colonialism is one of the major themes of African cinema.

solidarity in the face of adversity, while drawing attention to village philosophy and ethics.

Thus Med Hondo's very beautiful *Saraaunia* (1986), or *Emitaï* ("Thunder God", 1971) and *Ceddo* ("Outsiders", 1977) by Ousmane Sembène, highlight the life of village communities in their struggles against foreign invaders, whether military as in the first two films, or religious as in the third. The social order, which has been destroyed by the modern world, is particularly well portrayed in these films. In *Saïtane* (1973), by Oumarou Ganda, the harmonious balance of power collapses very swiftly when such occurrences as adultery or incest (as in *Niaye*, 1965, by Ousmane Sembène) start to influence the behaviour of those who hold these powers in trust. It is nevertheless remarkable to observe that, once the drama has been worked out, the rigour of tradition restores order. In *Yeelen*, the confrontation between father and son causes natural disasters as well as serious economic and social disruption. But the story ends with a prophecy foretelling that a day will come when the Bambara will once again be a great nation.

While the themes represented in African films are for the most part universal, the unity of time, space and rhythm found in them is resolutely a part of African culture and civilization. Time, like space, is elastic, and does not place a frame around the action. Events occur as if the eternity of the gods had dawned on Earth, and as if, despite the thousand-and-one preoccupations of everyday life, time did not matter. Just like the wide, generous open space of the African landscape, time cannot be hemmed in by man and it takes its natural course, independently of human activities. By contrast, the rhythm of these films is beaten out by human hands. In counterpoint to time and space, rhythm is provided by movement, by the most mundane gestures, or by speech, which always takes on an oracular tone. This is what makes it altogether human.

In *Lettre paysanne* ("Letter from the Country", 1975), by Safi Faye, we watch the everyday life of the film-maker's own village during the winter months. Work in the fields in the mornings, the midday meal-break, as day follows day, punctuated by scenes under the palaver tree and snatches of conversation, all of which are strands imperceptibly weaving the fabric of the film. The beauty of the countryside, the peace of the natural world, the weight of time, although strongly present, do not obscure the questions of survival that the village must face, and do not deflect any of the criticism that may be aroused by traditional customs, manners and morals.

Set against this highly political and intellectual form of cinema, there is also the commercial cinema of the English-speaking countries. The Nigerian Ola Balogun, who is probably the only African film-maker to have directed and produced more than ten full-length feature films, has had a run of successes with works adapted from Yoruba theatre, in which marvellous stories unfold in a universe of music and dance. His output also includes works of a mythological nature, such as *The Black Goddess* (1979), or political films like *Cry Freedom* (1980), a protest against colonization. These works are, nevertheless, closer to Western cinema than those of the French-speaking African countries.

Although the wealth and complexity of African cinema cannot be denied, it is nevertheless not equipped to compete against the powerful world film industry. Two major obstacles stand in its way: technique and funding. This cinema emerged and developed virtually without support of any kind, whether financial, political, cultural or technical. Thirty years later, the working conditions of film-makers are still extremely precarious. Indeed, cinema came late to the African continent, at a time when "maximum technical know-how" has become necessary in order to make a film with universal appeal. *Yeelen* by Souleymane Cissé shows that, with adequate funding and techniques, a film can emerge from the ghetto in which African cinema is at present languishing. Since mainly experimental and art films are being produced, the African economic sector has not concerned itself with setting up a film industry. But the growing interest shown by international producers in this *cinéma d'auteur* will, perhaps, result in a breakthrough. ■

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Sinan the Magnificent

by Aptullah Kuran

The work of the great Turkish architect lives on, four centuries after his death

IN 1988 Turkey is preparing to commemorate the 400th anniversary of the death of a great architect. For half a century this architect designed and supervised all major buildings in Istanbul and was responsible for numerous projects throughout the vast Ottoman empire. He is given credit for over four hundred buildings. But more significant than the number of works ascribed to him is the quality of the architecture he produced and the impact he has had on those who have followed him. If he symbolizes the climax of the Ottoman classical period, it is because he synthesized the experience of the two preceding centuries to achieve a universal architecture. This

Photo © Selda Besnier-Kilıçoğlu, Paris

◀ The Süleymaniye Mosque (1550-1557), Istanbul, built by Sinan for Süleyman the Magnificent on the central of the seven hills of the old walled city, conveys a powerful impression of spatial unity. The two minarets at the corners of the main structure are taller than those flanking the portico leading into the courtyard, contributing to the gradual build-up towards the central dome. The mosque complex is included in the international campaign launched by Unesco to safeguard the cultural heritage of Istanbul and Göreme National Park.

man was Sinan ibn Abdülmennan, Chief Court Architect under three sultans from 1538 until his death in 1588.

Little is known about Sinan's origins and childhood. He came from the province of Kayseri (the ancient Caesarea Cappadociae) and was conscripted, probably in 1512, to serve in the Imperial army. Nine years later he took his place among the ranks of the Janissaries. From 1521 to 1538, he participated in the various military campaigns of Süleyman the Magnificent. These campaigns were of utmost importance to Sinan's development as an architect, for not only was he commissioned to build or repair military structures such as bridges, fortifications and warehouses, but he was also given the opportunity to visit many cities of historical importance. It would not be unreasonable to contend that an architect of Sinan's calibre would have examined and evaluated any architectural monument he came across on the campaign routes, and stored the information away in his mind for future reference.

Sinan's Janissary education included the learning of a craft: he became a master carpenter. The experience gained from building with wood stayed with him throughout his career. During his active military service he restored old mosques and shrines when the army wintered in a major city. Through the 1530s, while he was stationed in Istanbul between campaigns, he designed small buildings in and around the capital. His earliest works consisted of three tiny mosques, which have not survived in their original condition. They must have attracted the attention of influential figures at Court, however, as upon the death of the Chief Court Architect in 1538, Sinan was appointed in his place. With the construction of the Haseki Mosque, Istanbul, which he built for Süleyman the Magnificent's wife Hürrem Sultan (Roxelana), there began one of the most remarkable careers in the history of architecture.

Although a great many detailed accounts exist relating to the construction methods of Ottoman architecture, no theoretical treatise dating from the sixteenth century or earlier has come to light. Architecture was considered to be a craft and the secrets of the trade, passed on from master to apprentice, were apparently well guarded. For this reason, Sinan's professional mind is inaccessible to us. However, it is clear from his buildings that he was familiar with Euclidean geometry, that he understood the principles of space organization, and that he had a feeling for the subtle manifestations of centrality and axiality in architecture.

Sinan's early building complexes, such as the Haseki Mosque and the Mihrimah Sultan Mosque, Usküdar, are not noted for their site planning: the arrangement of the buildings lacks geometry and order. But two other great building projects deserve special comment. These are the mosques of Shehzade (Prince) Mehmed (1543-1548) and Süleymaniye (1550-1557), both in Istanbul and both commissioned by Süleyman the Magnificent. He had the first built in memory of his favourite son who died of

smallpox at the age of twenty-two, and ordered the second to provide his capital city with a splendid higher education centre.

With its quadriform superstructure, symmetrical plan, and vast prayer hall of an austere simplicity in contrast to the wealth of external decoration, the Shehzade Mehmed Mosque marks a turning point in classical Ottoman architecture. For it is in this mosque that Sinan reverses the principle of interiority, fundamental to Islamic building, by emphasizing the outer skin of the structure.

The mausoleum of the prince, which stands among other tombs in the traditional cemetery garden behind the mosque, is similarly enriched by an ornamental veneer on the outside as well as being colourfully decorated inside. Its interior walls are tiled from the floor to the base of the dome in blue, turquoise, lilac, green and yellow. On the outside, the faces of the octagonal structure are constructed of polychrome stonework surmounted by a ribbed dome on a fluted circular drum.

Sinan considered the Shehzade a work of his "apprenticeship". But his patron Süleyman the Magnificent must have judged it a masterpiece, since barely two years after its completion ground was broken for the finest of the Sultan's mosques in Istanbul. The Süleymaniye Mosque and its numerous attendant buildings were built on and around a vast rectangular plaza, created by means of an elaborate system of foundations and retaining walls on a hillside overlooking the Golden Horn, on the Bosporus.

On the west of the mosque compound are *madrasahs* (theological schools) and the medical *madrasah*—all built on a terrace with a row of thirty-five shops tucked under it. To the north are the hospital and the kitchens, with guest rooms for the caravanserai in the basement, facing the street at the back. Overlooking the Golden Horn on the east side of the plaza, behind the shopping street at a lower level, are the second pair of *madrasahs*—the Third and Fourth—unique formations with stepped arcades and rooms on either side of sloping inner courts. Placed under the twin *madrasahs* is a string of eighteen more rooms for graduate students. On the south side of the mosque, in the traditional cemetery garden, stand the octagonal tombs of Süleyman the Magnificent and his wife Hürrem Sultan.

Unlike the Süleymaniye, Sinan's third and last monumental building complex, the Selimiye Mosque in Edirne (1569-1575), does not have a large number of buildings. Only a covered shopping street and two small *madrasahs* accompany the monumental mosque that rises in the middle of a great rectangular plaza.

The Selimiye is Sinan's masterpiece. The interior architecture is completely reflected in its external form which embodies striking contrasts of horizontals and verticals, curved and straight lines, solids and voids, and also a marked distinction between the load-bearing structure and the lace-like screen walls. Buttressed by four minarets, over 70 metres in height, at the corners of the prayer hall, and surmounted by a huge 31.5-metre dome on eight elephantine pillars, the Selimiye Mosque achieves an expression of centralized geometrical order.

Centrality in Ottoman classical architecture was a philosophical statement of the unity of space under a vast dome, symbolizing the totality of the universe and the Oneness of Allah. The integration of architectural space brought with it the need for height; stressing the vertical dimension fostered exteriority by increasing the amount of exposed wall surfaces requiring articulation. This requirement was successfully met by Sinan in the sixteenth century when he brought the rationale of the centralized building to its logical conclusion in his superb imperial mosques. Where Asia embraced Europe and Islam and Christianity overlapped, he integrated the precepts of Islamic interiority with Graeco-Roman exteriority to produce a universal architecture. ■

Photo © Selda Besnier-Kiliçoğlu, Paris

▲ **The Selimiye Mosque (1569-1575), built at Edirne in the reign of Selim II, son of Süleyman the Magnificent, is considered to be Sinan's masterwork. The immense dome is surrounded by four incredibly slender minarets (90 metres high including the conical spires), which reinforce the upward movement of the composition.**

Photo © Selda Besnier-Kiliçoğlu, Paris

◀ **The Shehzade Mehmed Mosque (1543-1548), Istanbul, was built in memory of Prince *(Shehzade)* Mehmed, one of the sons of Sultan Süleyman the Magnificent. This mosque, the first of Sinan's masterpieces, marks a turning point in classical Ottoman architecture. The slender, two-balconied minarets between the courtyard and the prayer chamber are ornamented with low-relief carvings, and Sinan's use of a succession of different-sized domes gives the complex a pyramidal aspect.**

Photo © Selda Besnier-Kiliçoğlu, Paris

◀ **The Moğlova aqueduct (1553), a constructional masterpiece on the outskirts of Istanbul, forms part of the system devised by Sinan to supply the capital with water.**

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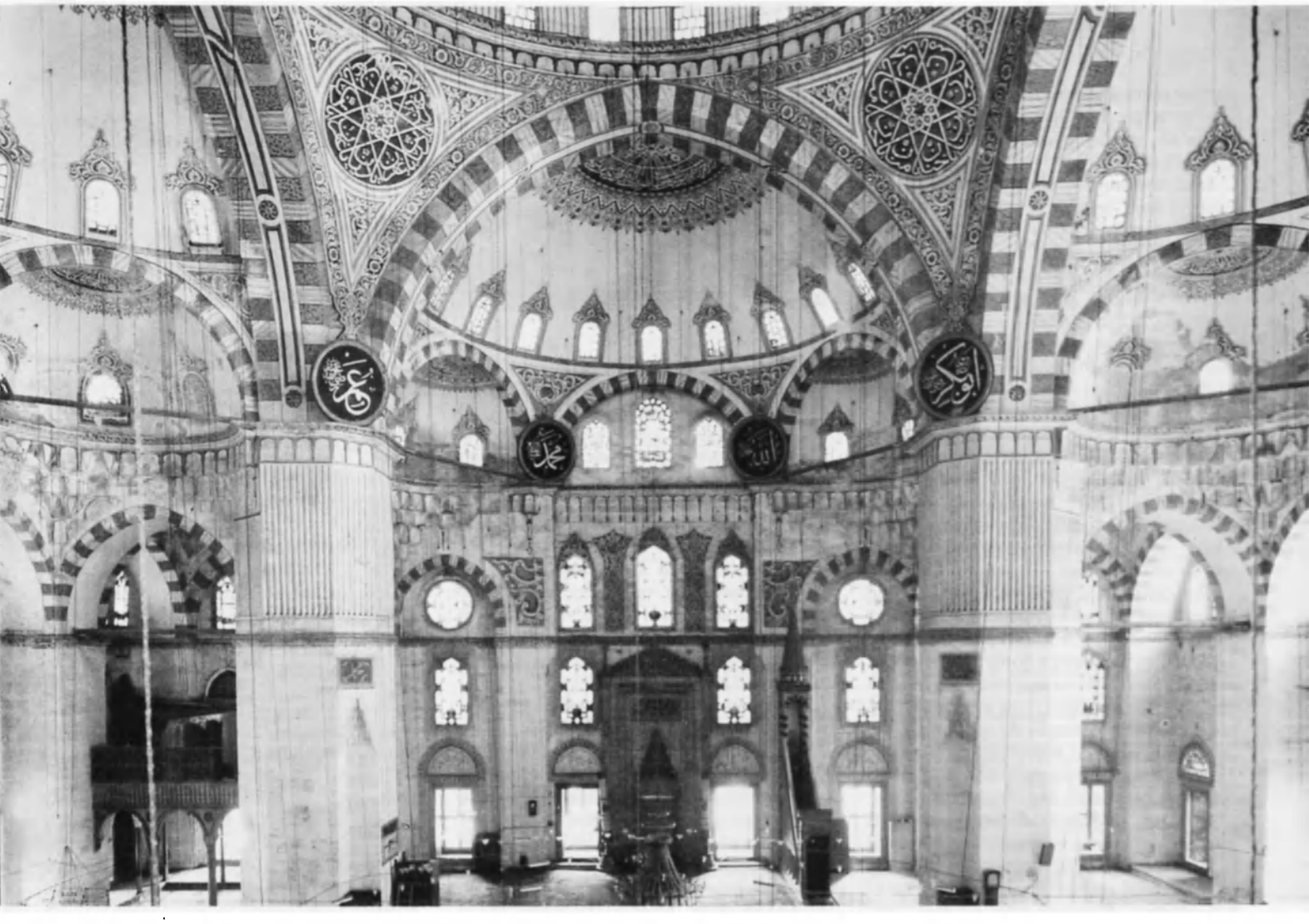
Sinan and Palladio

The parallel development of two master-builders

by Selda Besnier-Kiliçoğlu



▲ **Thanks to the skilful positioning of a great many openings, the interior of the Selimiye Mosque, built by the Turkish architect Sinan at Edirne (Turkey), is bathed in a strong light which intensifies the impression of spatial unity created by the vast dome.**

THE theoretical treatise of the Italian architect Andrea Palladio (1508-1580), *I quattro libri dell'architettura* (1570; *The Four Books of Architecture,* 1716), is considered to be a crucial landmark in the history of art and architecture. But what is the significance of the work of Mimar Sinan (1489-1588), the greatest Ottoman architect of the same century? Was he simply a builder, with no original architectural theory to his credit?

Granted, unlike his Italian contemporary, Sinan did not leave any treatise setting out the principles of a new theory of architecture. But it is unthinkable that such a master of design, who established rules of town-planning and devised a general hydraulic system for the water supply of the capital of the Ottoman Empire, was working without any theoretical or critical rationale or scientific method when he built 112 mosques and 42 *masjids,* 79 *madrasahs* (Islamic schools), 53 *hammams* (public baths), 42 *turbehs* (funerary monuments) and 31 caravanserais.

On the contrary, an analysis of Sinan's architectural works yields ample proof of the fact that he devised a conceptual methodology similar to that defined by Palladio, which he developed and applied throughout his career: a process of questioning accepted practices, which is conventionally known as Mannerism.*

These two architects, Sinan in the East and Palladio in the West, produced very different types of work: the former designed primarily religious buildings, while the latter built a series of villas in the Veneto region of Italy. But the basic similarity between them is the parallel development in their architectural methods: gradually

*Art style that arose in Italy around 1520 and spread throughout Europe, characterized by a break with the formal equilibrium of the Renaissance, the creation of deliberate tension and a tendency to artifice which was to lead into the baroque style of the 17th century. *Editor.*

Photo Fabbri © Artephot, Paris

The Villa Cornaro (c. 1560-1565), built by the Italian architect Andrea Palladio at Piombino Dese, near Vicenza. The columns and pediment of the portico recall the monuments of Antiquity.

parting company with their sources, building up a precise figurative lexicon and, above all, searching for typologies and formal variants.

Thus the various planometric combinations in their respective output can be reduced to a single spatial pattern, square in shape: the "nine spaces" of Palladio's villas, and the "spatial unity created by a dome" of Sinan's mosques. The adoption of such a formula, which would undergo many changes as one architectural accomplishment followed another, attests in both cases to the application of a rigorous and critical conceptual method.

The art historian Rudolf Wittkower demonstrates in *Architectural Principles in the Age of Humanism* that all Palladian villas have a regular rectangular outline, the "nine spaces", modified by two symmetrical wings, which determine the principles of spatial distribution.

The conceptual ideal of Sinan, on the other hand, whose key pattern was one of "spatial unity" on a very large scale, was achieved by means of a dome. The Turkish architect worked on a great many small sites, and the technical skills that he thereby acquired were subsequently put to use on the great imperial construction projects. Like Palladio, Sinan followed a method based on Mannerist experimentation.

The many mosques that Sinan has left us add up to a very extensive architectural typology, in which the stability of the dome is secured by means of various systems of construction. We shall refer to only three essential examples: the Shehzade Mosque (1543-1548) and the Süleymaniye Mosque (1550-1557) in Istanbul (the former Constantinople and ancient Byzantium) and the Selimiye Mosque (1569-1575) at Edirne (formerly Adrianople).

In the Shehzade Mosque, Sinan's first masterpiece, the great dome of the prayer chamber rests on four piers. Four half domes surround this central structure, relaying the thrust to the side walls. The square layout is completed by four subsidiary domes placed at the corners of the building. In contrast to Byzantine buildings, the central dome is supported not by barrel vaults but by the half domes. This technical arrangement, which appears regularly in a variety of combinations in Sinan's work, helps to lighten the outline of very massive buildings. The slender colonnades decorating the lateral façades and the main portico serve a similar purpose.

In the Süleymaniye Mosque, also designed on a square plan, the central dome again rests on four piers, but here compensation is made for the outward thrust by two half domes in the longitudinal axis and two aisles supported by four columns in the transversal axis. These side aisles are capped by small domes of various sizes which are alternated to eliminate monotony.

This type of layout, with a central dome flanked by two half domes, has often, unfortunately, misled art historians, whose analyses have not taken account of the Mannerist aspect of Sinan's style. This failure to recognize the continuous development of a syntactical conceptual methodology leads them to see the Süleymaniye Mosque as a copy of the sixth-century Byzantine basilica of Hagia Sophia, Istanbul.

It is obvious on entering these buildings that a planimetric likeness is not the same as a volumetric similarity. In Sinan's work, the planimetric pattern is always linked to a hierarchy of architectural elements in the total composition. In Hagia Sophia, the observer very easily grasps the importance of the side aisles, whereas the Süleymaniye Mosque gives the impression of a unified space, emphasized by excellent lighting from the 128 bays set at regular intervals around the walls. There is another basic distinction: the minarets on either side of the portico leading into the courtyard have two balconies, whereas the two taller minarets attached to the main body of the mosque have three balconies each. This hierarchical arrangement of architectural elements is the secret of the ingenious adaptation of the building to the steeply sloping site. The domes, half domes and minarets, all varying in size, combine to create a harmonious pyramid-shaped silhouette which embellishes the city skyline.

The Selimiye Mosque, Sinan's masterwork, marks the apogee of his search for "spatial unity created by a dome". The central dome rests on eight fluted piers on an octagonal plan. Its originality lies in the fact that these piers are half embedded in the walls which enclose the central space, so that the arcades appear to rise directly from the piers. This composition produces a central area of great visual complexity, and recalls the determining influence of the early Sassanid dome, supported by squinch arches. Moreover, thanks to the skilful positioning of a great many openings, the interior is incomparably well lit.

By placing minarets at the four corners of the prayer chamber, Sinan uses them as buttresses to compensate for the lateral thrust, and creates an exterior that is as rich in architectural detail as the interior which we have described. In elevation, the hierarchy of structural elements is dominated by the mighty dome. The elevation precisely reflects the plan, with the result that there are no external colonnades.

Palladio assimilated the characteristic styles of the architectural history of his own culture: he used the pilasters and rusticated ornamentation of the early Renaissance Florentine style in the Palazzo Thiene, the high classical style in the Villa Rotonda, and baroque decoration in the Palazzo Porto Breganze. Sinan, likewise, referred to decorative models which belonged to the cultural heritage of his region: arched windows of Byzantine origin in the central domes, to transfer downward the dynamic thrust essential to the support of such structures; ogee arch openings, showing Persian influence, in the walls of the main structure in order to emphasize the vertical composition.

But these two master builders never, at any time, plagiarized the models of their cultural heritage. Their genius lies in having assimilated the constructive and ideological rationale underlying that heritage in order to found a Mannerist conceptual methodology of their own. ■

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