A window open on the world

The UNESCO Courier

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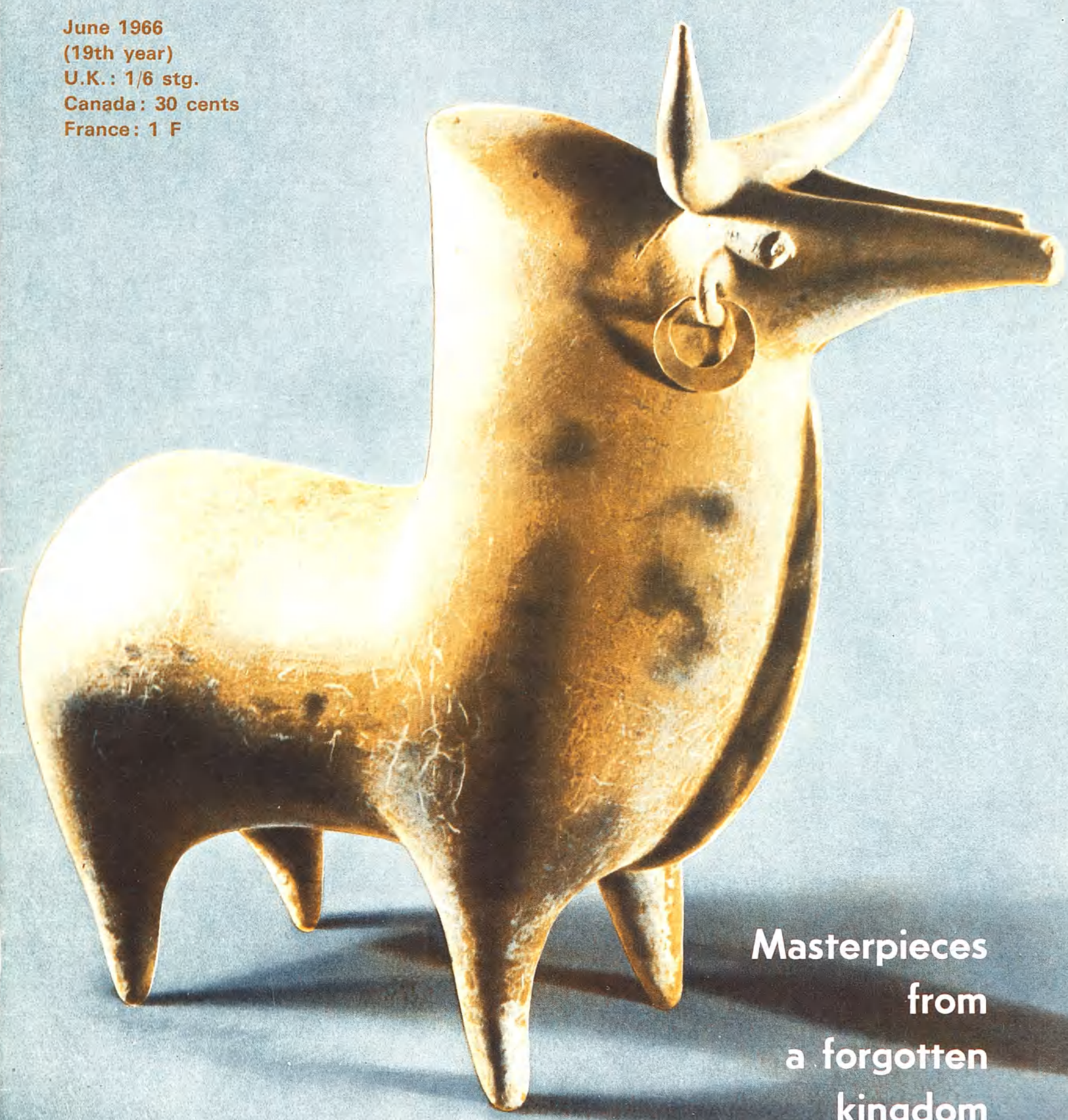

Masterpieces from a forgotten kingdom

Negotiations between William the Conqueror and Harold of England

The building of the Norman Fleet

William's fleet sets sail for England

Cooks prepare a meal for William and his barons

The Bayeux Tapestry

TREASURES OF WORLD ART 6

With its hundreds of human figures, scenes from husbandry and the chase and its minute detailing of military techniques, the Bayeux Tapestry is a unique illustrated guide to life in war and peace during the eleventh century. The work is actually an embroidery on which needlewomen of that century used woollen threads of 8 colours to depict the Norman conquest of England. With its 72 panels spread across a linen band measuring 70 metres by 50 centimetres (230 ft. by 20 ins), it could be called an ancestor of the cartoon strip. Above, scenes from the epic of 1066.

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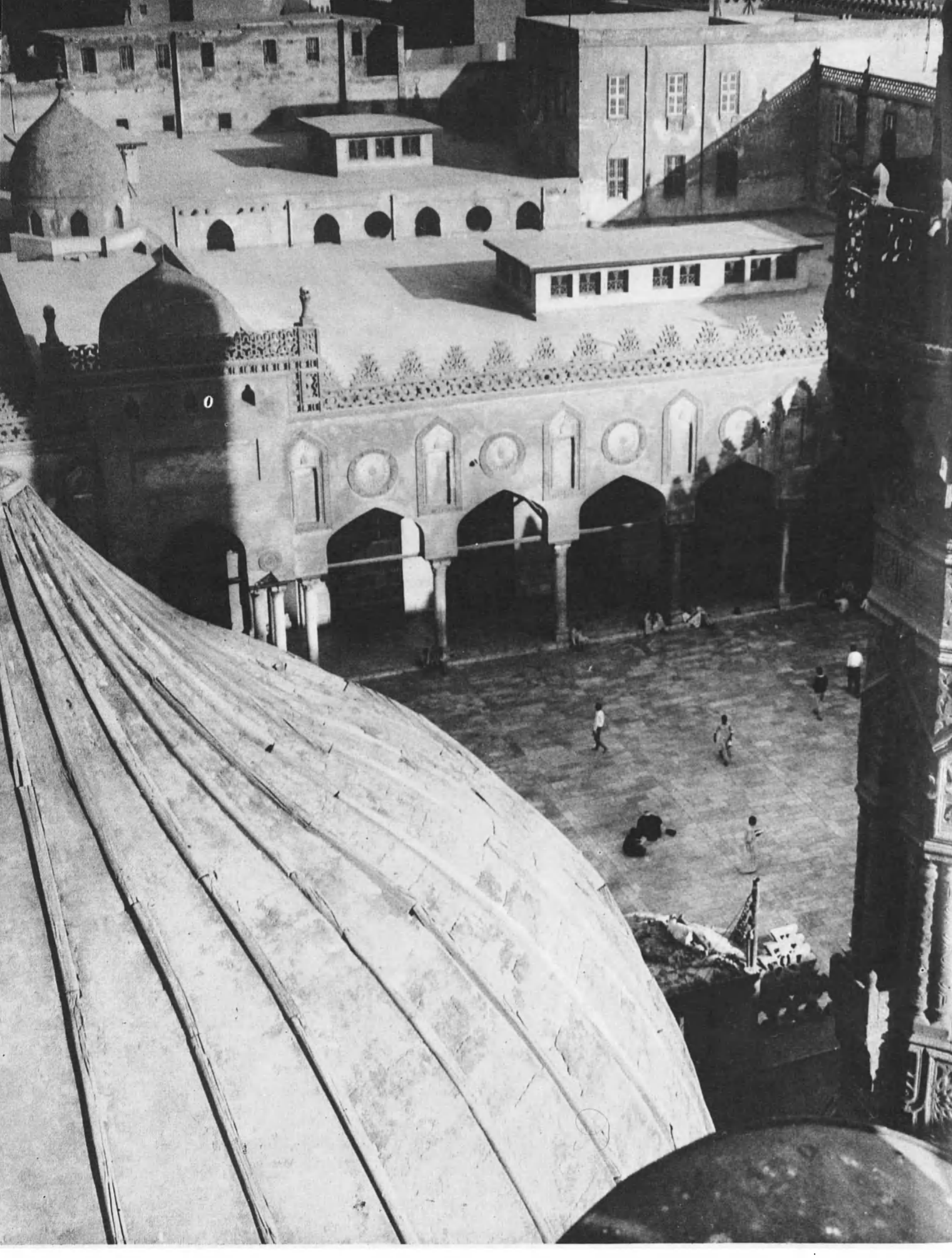
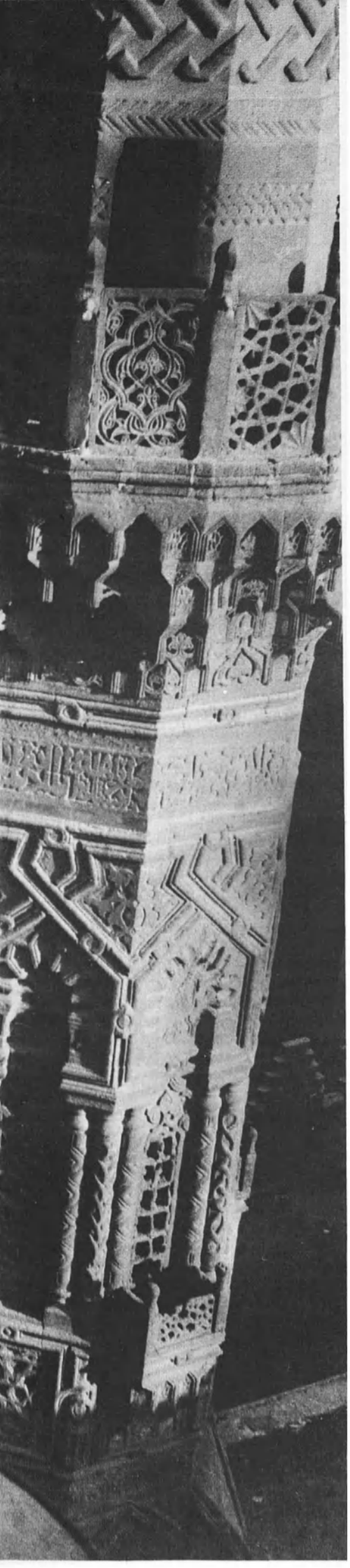
Cover photo

This humped bull with gold earrings in its pierced ears is actually a vase whose spout is formed by the animal's muzzle. A red pottery figurine, 3,000 years old, it was found in northern Iran when archaeologists uncovered the royal cemetery of Marlik, a long-forgotten kingdom. Marlik's tombs yielded a remarkable collection of funerary objects, including ritual vessels and figurines, ornaments and jewellery, and pottery of all kinds (see page 16).





Al-Azhar University, where the historian, Ibn Khaldun, taught after moving to Cairo in 1383. He spent his last years in this city which he described as the "metropolis of the world enlightened by luminaries of learning". He died there in 1406 at the age of 74.

IBN KHALDUN
MAN OF HISTORY

A universal history of the world written six centuries ago by Ibn Khaldun establishes this great Arab scholar as the first person to treat history as the proper object of a special science. The story of this forerunner of the modern historian, presented below, includes a recently-discovered account in Ibn Khaldun's own words of his memorable meeting with Tamerlane the Conqueror.

by Barbara Bray

HE opened his eyes on a life of culture and elegance, where fountains played in sunny courtyards, where books and music and quiet meditation divided the time with exciting and often dangerous affairs of state.

His family, which originated in the Hadramaut in Southern Arabia, had emigrated from there to Spain in the eighth century, during the early years of the Moslem conquest. By the eleventh century they had become the intellectual and political leaders of the city of Seville. But before the middle of the thirteenth century and in time to escape the Christian reconquest of the town, these proud patricians crossed over into Northwest Africa, where influential friends and relations soon helped them to establish new positions of wealth and honour.

In order to understand the world into which Ibn Khaldun was born, and which he spent his life studying and analysing, we need to take a general look at a period of history too often neglected, and remind ourselves of what Arab civilization as a whole, as well as Ibn Khaldun in particular, contributed to the sum of human knowledge.

After the founding of Islam by the Prophet Mohammed around 630, the new civilization rapidly spread outwards from Arabia its centre until by the middle of the tenth century, when it was at its zenith, it included by far the greater part of the inhabited world. To the west it took in Egypt and the entire North African coast, the islands of Sicily and Crete, and nearly all of Spain. To the north, Syria, Armenia and the south-east regions of the Caucasus were under Islamic rule; then, further east, Mesopotamia, Iraq, Persia and Afghanistan, Transoxania and parts of India's northern plains.

Both the cultural and geographical horizons of Europe were bounded in nearly all directions by Islam, which enjoyed the summit of its prosperity at the time when the civilization of the West slumbered in its deepest darkness.

By the twelfth century the decline of the medieval Islam had set in, and in Ibn Khaldun's lifetime it presented

CONTINUED ON NEXT PAGE

BARBARA BRAY *is a journalist, translator and literary and dramatic critic, and was formerly a lecturer in English at the University of Alexandria. This article is adapted from a radio programme she wrote for Unesco to commemorate the birth of Ibn Khaldun.*

IBN KHALDUN *(Continued)*

Unable to keep out of hot water

a spectacle which while still splendid was fatally touched by disintegration. But in the years of its greatness it not only kept alight and handed on the torch of knowledge kindled by Greece, but also made valuable contributions of its own to human understanding and power.

Navigation, commerce, architecture, together with nearly all the arts and crafts were cultivated, and their fruits and techniques handed on to the West.

In science and philosophy, Arab thinkers first preserved what the Greeks had won, then in certain important, though mostly practical ways, developed and perfected it, thus acting as a necessary connecting link between ancient and modern. European interest in the works of Aristotle, for instance, was first awakened through acquaintance with Arabic thought.

The Arabs produced eminent scholars and practitioners in medicine, astronomy, physics and the natural sciences. They were the inventors of algebra and trigonometry, and they contributed much to the development of arithmetical calculation.

The literary and purely intellectual influences of Islam are harder to trace than the scientific ones, and here as in every field of Arabic studies much necessary material is lost or still unexplored.

By the twelfth century the works of Arab scholars had begun to be translated and accepted as authorities in the West—in Europe; and in the thirteenth century the Arab world and the West were intellectually much more closely aligned than they have ever been since.

In the sixteenth century the revolution brought about by Copernicus in astronomy, the reform of alchemy and medicine by Paracelsus, and the new anatomy of Vesalius struck great blows at traditional Arab erudition. Then when the Moors were defeated and the Moslem empire in Europe came to an end, all the eastern learning that had not already been assimilated was lost.

But much *had* been assimilated, and Arabic no less than Hellenic lore continued to be respected right down until both were crushed by the advent of modern scientific method.

Of this method Ibn Khaldun, the first man to treat history as the proper object of a special science, was an amazingly early forerunner. How did he come to be so much ahead of his time?

For an answer to this question we have to look at the circumstances of his life.

When he was seventeen Khaldun lost both his parents and many of his teachers in the Black Death. Three years later he was given an important appointment at the court of the Hafsid rulers of Tunis, but he preferred to leave this and travel gradually westward across North Africa, pursuing his studies, and passing the years from 1354 to 1363 at the Merinid court in Fez. The development of a Moslem scholar was regarded as a lifelong process, and the list Khaldun scrupulously gives of the men at whose feet he sat is a formidable one. But in giving the list he was also presenting his academic credentials, and these show that his interests were wide, not to say encyclopedic, rather than specialized. This is an important factor in relation to his life-work.

North Africa was at this time divided into three warring kingdoms, each of whose ruling dynasties was torn by internal dissension. It was here, taking an active part in politics, that Khaldun got most of his material for his theories about the rise and fall of nations. In such an atmosphere it was hard for someone like him to keep out of hot water. At one period he found himself on the wrong side and spent nearly two years in prison, and later he found it prudent to cross over into Spain, to Granada. But in 1365 he was back in North Africa, in Bougie, as Prime Minister.

The nine years from 1365 onwards were the most precarious in all Khaldun's hazardous career. It was no easy matter to be always on the right side in the complicated and fluid chaos that North Africa had become. Khaldun's services as judge, civil servant and politician were always in demand, and all his attempts to escape to scholarly peace and quiet were foiled by suspicious rivals and demanding princes. Finally, however, he managed to get permission from the ruler of Tunis to install himself and his family in a secluded pavilion at Ibn Salamah in the province of Oran. Here he spent over three years in comfort and solitude, and started to write his great history of the world.

"I completed the Introduction in the remarkable manner to which I was inspired by that retreat, with words and ideas pouring into my head like cream into a churn," he recorded.

It took him three more years, and the opportunity to consult the libraries in Tunis, before he completed his enormous work, and even after that he was always correcting it and bringing it up to date.

CONTINUED ON PAGE 8

From "The Muqaddimah" by Ibn Khaldun

MEDIEVAL WORLD MAP. The "Muqaddimah" or "Prolegomena", which Ibn Khaldun wrote as an introduction to his monumental history of the world, outlines and discusses contemporary ideas on geography that were based on a still scanty knowledge of the globe. Ibn Khaldun illustrated his geographical descriptions in the "Prolegomena" with this map of the world on which the south is at the top and the north at the bottom. By turning it upside down one can pick out the outlines of Africa, the Mediterranean Sea, the Indian Ocean and the land masses of Europe and Asia in the northern hemisphere.

In Fez, Ibn Khaldun completed his education in association with the circle of scholars which Sultan Abu Inan had gathered around him for study and teaching. Here too he met many other scholars, physicians, astrologers and artists passing through the court of the sultan who was a great friend of scholarship. Above, the 14th-century Bab Sagma gate in Fez, Morocco.

Historian and conqueror face to face

The first volume consists of the *Muqaddimah* or *Prolegomena*, which is probably Khaldun's greatest claim to lasting fame, containing as it does the first real theory of history. Volumes II to VII deal with the events of the pre-Islamic world and Arab and Eastern Moslem history. But Volumes VIII and IX deal with the history of the Moslem West. Much of the material is based on first-hand knowledge, and it remains our most important source for North-west African and Berber history.

In November or December 1378, Khaldun returned to his old home in Tunis where he taught, did research, and of course made both friends and enemies at court. In 1382 he thought it best to ask the ruler's permission to make the pilgrimage to Mecca, and sailed for Alexandria on October 24, leaving his family behind, perhaps as hostages. From this time on his only contacts with the West were by correspondence and through meetings with travellers. He reached Alexandria after more than forty days at sea, and after a few weeks moved south to Cairo where, apart from occasional travels in the Moslem world to the east, he spent the rest of his life.

Egypt, ruled by the Mamelukes, was at this time the most stable and prosperous part of Islam. Khaldun was overwhelmed by the beauty of Cairo, with its colleges, mosques, crowded streets, and gardens that seemed to him like something out of paradise.

He was soon giving lectures at al-Azhar University and as soon as the post fell vacant the ruler Barqûq appointed him professor of Mâlikite jurisprudence in the Qamhîyah College. Soon after he was also made chief Mâlikite judge of Egypt. (The Mâlikite rite was one of the four schools of Islamic law.) So there he was once again in positions of both prestige and power.

In the year 1387 Khaldun went at last on his pilgrimage to Mecca, returning to new academic appointments and honours. In 1399 Barqûq died and was succeeded by his ten-year-old son. In 1400 Khaldun, as one of the four chief judges of Egypt, officially accompanied the young prince Faraj to Damascus, making a detour on the way back to visit Jerusalem and Bethlehem and other holy cities, Moslem and Christian, as a pilgrim. Christ is of course regarded as a prophet by Moslems.

By the autumn of the same year Timur—or, as we now call him, Tamerlane, "Timur the lame"—was threatening Syria with his cruel and all-conquering hordes of Tartars. Khaldun was obliged, much against his will, to bestir himself yet again and accompany Faraj as judge and counsellor on an expedition to relieve Damascus. A contemporary described this ineffective force as "an army without a general and a general without an army."

There were various inconclusive engagements between the two forces in the country outside Damascus, but in the first week of the year 1401 came news of a threatened revolt back in Egypt, and Faraj returned home, leaving at Damascus Ibn Khaldun and others of his retinue to fend for themselves and save the city if they could. These temporary residents of the city, together with the civilian authorities, decided to surrender, against the wishes of the military. Tamerlane knew of Khaldun's presence and expressed the desire to see him, so he was secretly lowered by ropes from the walls of the city and brought into the presence of the conqueror.

Until a few years ago the only authorities for this fabulous encounter were various Arab historians of the fifteenth century, who all obviously embroidered such facts as were available to them. In all hitherto known manuscripts Khaldun's own autobiography stopped in the year 1395. But less than twenty years ago three new manuscripts (the second and third are simply copies of the first), were found in Istanbul and Cairo. (The most important was annotated in Khaldun's own hand.) And they brought his story up to within a few months of his death.

So now at last, after five and a half centuries of speculation, we have a detailed and verbatim account of one of history's most colourful meetings.

At the time of their conversations, which were spread out over January and February of 1401, Khaldun was nearly seventy and Tamerlane about five years younger.

Khaldun was described by those who knew him as good-looking and attractive in manner, and this was confirmed by the speed with which he was always admitted to favour wherever he went. Tamerlane, according to an Arab chronicler, was "tall in stature, with a large brow and a great head, and very strong. His complexion was white mixed with red; he was broad-shouldered, had thick fingers, a flowing beard, was paralysed in one hand and lame in his right leg. He had brilliant eyes, a loud voice, and was fearless of death. He reached the age of eighty in full enjoyment of his senses and strength."

They were a well-matched pair who lost no time in sizing one another up. Although Khaldun as a historian was certainly intrigued to meet so outstanding a maker of history, his chief concern was to extricate himself and his colleagues from Tamerlane's clutches and get safely back to Egypt. Tamerlane, on the other hand, knew that Khaldun was the greatest living expert on the Maghreb (this is to say, the Western Islam from Tripoli to Granada), and was anxious for military reasons to attach him to his intelligence services.

Let Khaldun now take up the story in his own words, from the moment of his first arrival in Tamerlane's reception tent:

When my name was announced he summoned me and as I entered the audience tent he was reclining on his elbow while platters of food were passing before him, which he sent out one after the other to groups of Mongols sitting in circles in front of his tent. Upon entering I spoke first:

Peace be with you—and I made a gesture of humility. Thereupon he raised his head and stretched out his hand to me, which I kissed. He made a sign to me to sit down. I did so just where I was, and he summoned from his retinue one of the erudite Harrafito jurists whom he bade sit there also to serve as interpreter between us.

Tamerlane got straight to the point by asking Khaldun questions about the Maghreb, which Khaldun skillfully evaded. They fenced for some time, then Tamerlane got tired of beating about the bush.

— *I am not satisfied*, he declared. *I should like you to write down for me a description of the whole country of the Maghreb, treating all its features in such a way as I might seem actually to see it.*

Bowls of *rishta*—a sort of macaroni in soup—were then brought in. Khaldun took some and did it justice, and this seemed to go down very well with his host.

But soon they both fell silent. Khaldun couldn't help thinking of what his fate would be if he made a wrong move.

At this moment news came that the city gates had been opened and the civil authorities were coming out to surrender.

Tamerlane appeared to be having trouble with the lame knee which had been wounded by an arrow in his youth, and so was carried out, with bands playing "until the air shook with them," and rode off towards Damascus.

Khaldun duly set about writing his account of the Maghreb. He was left unmolested, although around him the city was being sacked and burned.

The paper written and handed over, Tamerlane treated Khaldun with various marks of respect, asking him to give his opinion on legal matters, for example. But they still had not got round to the vital question of whether the scholar was to be allowed to return home to his studies.

Khaldun decided he had better take the bull by the horns—but as tactfully as possible.

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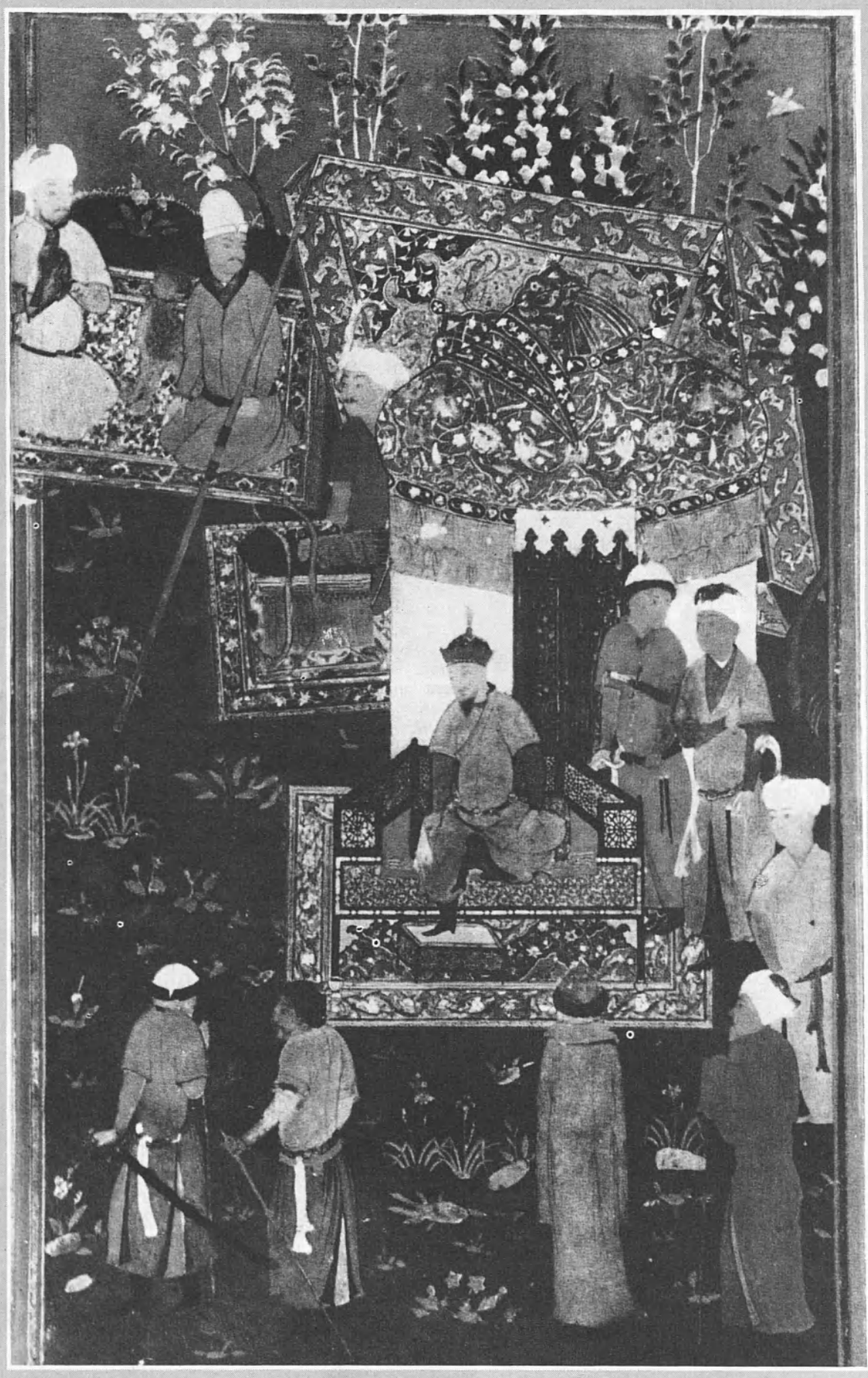


AN AUDIENCE WITH TAMERLANE

Tamerlane granting audience to subject princes on the occasion of his accession (15th century Persian miniature). Founder of the second Mongol empire, Tamerlane conquered all of the Middle East and Eastern Europe, but was also known as a patron of art, literature and science. He was born four years after Ibn Khaldun, in 1336, and died one year before the great Arab historian, in 1405.

Author of the first real theory of history

I chose from the book market an exceedingly beautiful copy of the Koran, a beautiful prayer rug, a copy of the famous poem, al-Burda, *by al-Busiri in praise of the Prophet—may Allah bless him and grant him peace—and four boxes of the excellent Cairo sweetmeats. I took these gifts and entered to him in the palace of Qasr al-Ablaq.*

Khaldun pondered how to begin.

— May Allah aid you—I have something which I wish to say before you, he said.

— Speak! replied Tamerlane.

— I am a stranger in this country in a double sense. First because I am away from the Maghreb. My other absence is from Cairo. I have come under your protection, and I hope that you will give me your opinion regarding what may solace me in my exile.

— Speak. Whatever you desire I shall do for you.

— What do I desire? My state of exile has made me forget what I desire. Perhaps you—may Allah aid you—will know for me what I desire.

— Move from the city of the camp and stay with me, and if Allah wills I will fulfil your highest aim.

For the moment Khaldun had to be content with this ambiguous suggestion. However, on the strength of it he did succeed in getting a safe-conduct for the Egyptian officials who had been left behind in Damascus.

But left alone Tamerlane seems to have reconciled himself to the idea of letting Khaldun go, and the next time they met he let this become apparent, somewhat wistfully, though characteristically he cut his losses in a very novel way. He asked Khaldun:

— You have a mule here?

— A mule? Yes.

— Is it a good one?

— Yes.

— Will you sell it?

— Sell it?

— I would buy it from you.

— May Allah aid you—one like me does not sell to one like you. But I would offer it to you in homage.

— I meant only that I would requite you for your generosity.

— Is there any generosity left beyond what you have already shown me?

— He was silent, writes Khaldun; *so was I. The mule was brought to him, and I did not see it again.*

— Are you going to travel to Cairo? asked Tamerlane.

Khaldun answered, delighted and surprised, but still nervous.

— May Allah aid you—indeed my desire is only to serve you . . . If the journey would be in your service, surely. Otherwise I have no desire for it.

— No, but you will return to your family and your people.

Khaldun rounds off the story by telling how he finally arrived back in Egypt. Soon after his return a messenger came with some money for the mule—not the full price, but the messenger swore that was all he was given. Khaldun warily asked the ruler of Egypt whether it was all right for him to take the money, and receiving an affirmative answer, pocketed it with a sigh of relief at having got off so lightly.

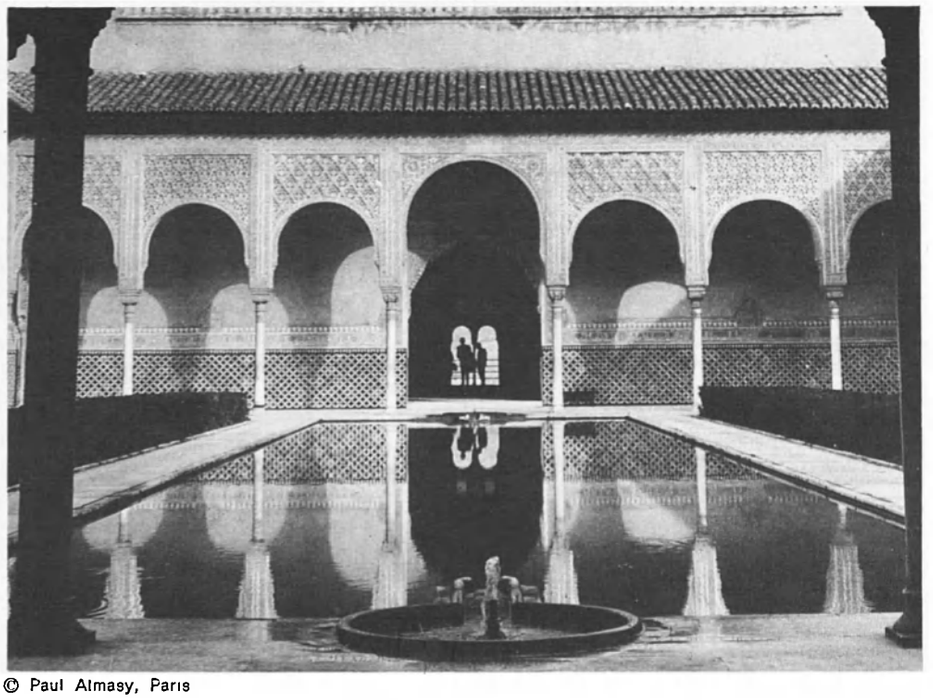
He lost no time in writing off to the Maghreb to tell about the information he had been forced to give, and to try to counteract any ill-effects this might have by giving his fellow-countrymen all the useful facts he could muster about Tamerlane. In fact Tamerlane never did attack North Africa. The rest of Khaldun's life was spent in study, writing and official duties. He died on March 17, 1406, and was buried in the Sufi cemetery outside the Nasr gate of Cairo. The site of his tomb is now unknown.

In the centuries that followed, the influence of Khaldun's teaching gradually gathered momentum, though his name is not found mentioned outside the Islamic world until 1636. Until the beginning of the nineteenth century it was the Ottoman Turks who showed the most constructive interest. Then European scholars began to discover in his work ideas hitherto considered to have been formulated more recently in the West.

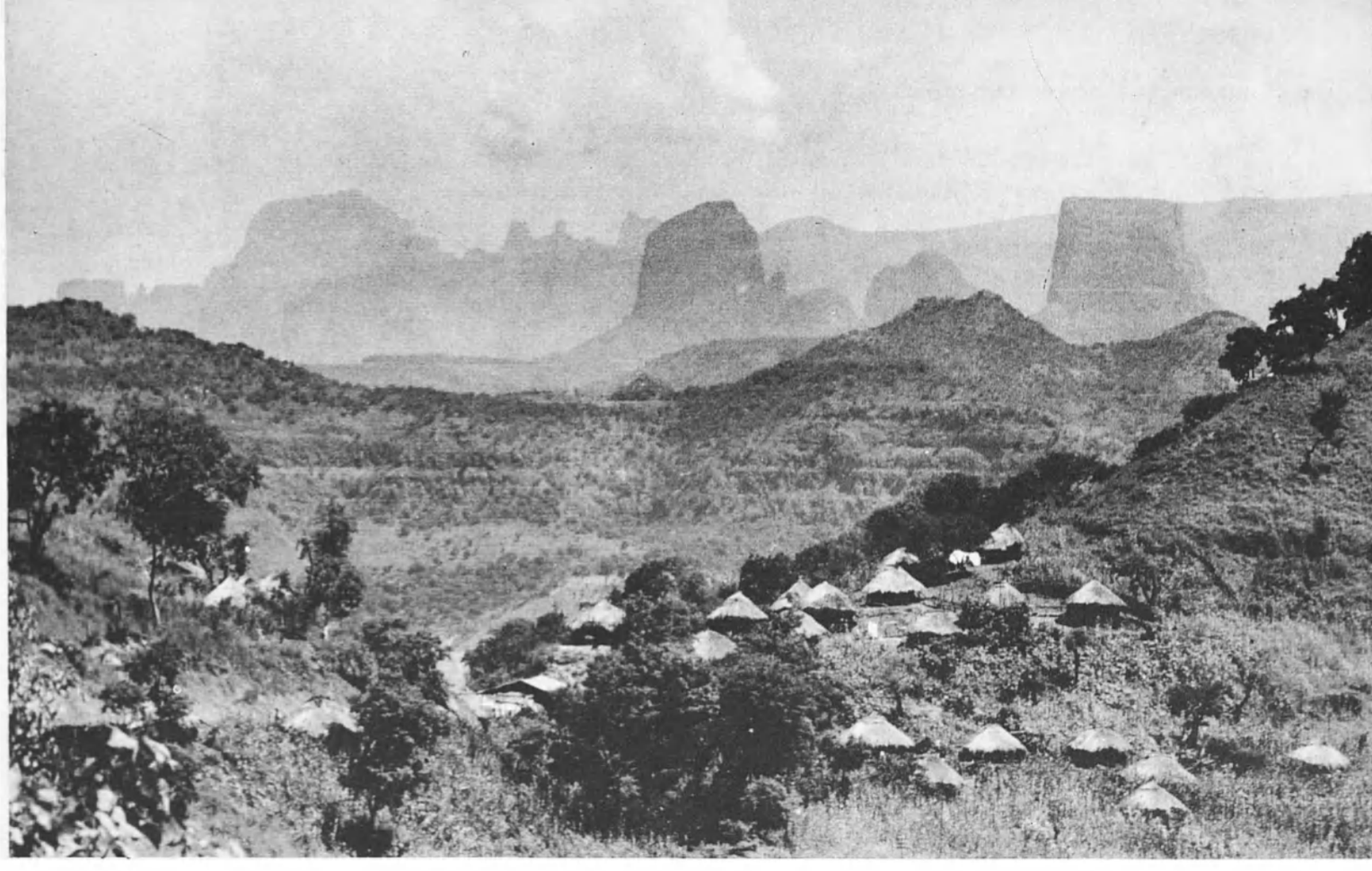
As far as we know Khaldun was the first historian ever to regard history not as a chronicle of more or less fortuitous events, but as a continuous, collective and organic movement governed by hidden but discernible laws. Moreover he identified the science of history with the science of civilization as a whole, and realized that only a study of man in all his innumerable activities can reveal the true significance of so-called historical events, so that the study of those events may act as a practical guide to the statesman.

So Khaldun, considering everything as a function of man and his social organization, takes all knowledge as his province, and re-evaluates every aspect of the highly developed civilization in which he lived.

The element of intellectual orthodoxy from which he could hardly be expected to escape only serves to emphasize the real originality and breadth of his mind. Picturesque and touching as it is, then, it is no wonder that Professor Arnold Toynbee, one of the most celebrated historians of our own day, cites this fourteenth-century Arab as the inspiration of his own monumental work, and salutes Ibn Khaldun as the founder of the science of history.



In 1362 Ibn Khaldun left Fez and went to the court of the King of Castille as ambassador of the Sultan of Granada. On his return the sultan rewarded him with lands and a palace in Granada. Above, the 14th-century Myrtle Court of the Alhambra, Granada, one of the palaces where the landscape garden art of the Arabs flowered in sheltered patios filled with flowers, shade, pools and fountains.



© Paul Almasy, Paris

Rugged landscape of Adi Arkai (north-west Ethiopia) strikingly illustrates the effects of subsidences in the earth's crust that have made the great rift valleys which cleave East Africa from Zambia to the Red Sea.

CRACKS IN A CONTINENT

Probing mysteries of the earth's crust in the rift valleys of Africa

by Brian H. Baker

THE rift valleys which traverse a large part of eastern Africa, and the high plateaux and volcanic mountains which are associated with the valleys, are some of the most beautiful and interesting parts of the continent.

The floor of the rift valley is often occupied by lakes, and the higher parts of the surrounding plateau are the sites of intensive agriculture, while the high volcanic mountains are covered with forests. It is the rift valleys and the associated uplifted plateaux and high volcanoes that provide much of the scenic variety in East Africa, and incidentally provide the basis for much of the agriculture, forestry and other industries.

The system of African rift valleys extends from Zambia through eastern Africa to the Red Sea, and continues northwards as far as Syria. This zone of fractures in the earth's crust is approximately 8,000 kilometres (5,000 miles) long, and represents one of the world's major structural features.

The rift valleys in Africa are now known to be connected in some way at the south end of the Red Sea with the even more extensive mid-ocean ridges which encircle the globe. The recognition that the African rift system is the extension of the mid-oceanic ridge of the Indian Ocean, via the Gulf of Aden, means that the system is part of the world rift system (see the Unesco Courier, October 1963).

Although the rift valleys of the African continent are likely to differ in some respects from the equivalent structures which are so much more extensive on the ocean floors, they are readily accessible for study, and provide excellent opportunities for research into several fundamental processes in the earth's crust, including volcanic action and vertical tectonic movements.

Now that the African rift system is seen to be part of a global structure —the most important structural feature of the earth's crust, in fact—its study has taken on a new significance. For example, if the continents have been drifting slowly apart during geological time, as some scientists believe, and if the mid-oceanic ridges are the zones

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BRIAN H. BAKER *is director of the Geological Department of Kenya's Ministry of Natural Resources and Wildlife, in Nairobi, and chairman of the Sub-Commission on African Rifts of the Upper Mantle Project of the International Union of Geodesy and Geophysics. He has written many studies on the geology of East Africa.*

Titanic forces at work 400 miles beneath us

along which the rupture of the original super-continent took place, then the African rift system may be the early expression of the break-up of this continent.

It is possible therefore that there is the opportunity in eastern Africa to study the early stages of continental fragmentation. In future geological ages parts of eastern Africa may become detached islands, like Madagascar is at the present day. It should be emphasized, however, that this is likely to be a very slow process, which would take many millions of years to operate.

Apart from the desirability of understanding more fully the surface structure of the African rift system and its connexion with the oceanic structures, there is also the question of causes. The major structural effects of the earth's crust—the long mountain ranges, the deep troughs filled with sediments, the zones of fracturing and vertical movement—are caused by forces generated in the plastic sub-stratum called the upper mantle of the earth, which occurs to a depth of about 700 kilometres (430 miles) beneath the thin, relatively rigid crust.

It is possible to obtain a surprising amount of information concerning the nature of the upper mantle by indirect geophysical methods, and study of the differences between the upper mantle in the zone of African rifts and elsewhere would provide information to help to understand the development of the crust of earth and the role of the upper mantle in its evolution.

The African rift valleys consist of a variety of structures, most of which are well preserved on the surface of the earth, since they were formed in comparatively recent geological periods, mostly, within the last 20 million years. Typically the valleys are troughlike subsidences of the earth's crust about 50 kilometres (30 miles) wide, varying from about a hundred metres to 1,500 metres (a few hundred to 5,000 ft.) in depth. In the northern part of the rift system the valleys traverse broad volcanic highland areas such as the Kenya and Ethiopia highlands, which rise to levels of over 3,000 metres (10,000 feet).

The sides of the valley are steep rocky escarpments, sometimes a single high escarpment, or a series of step-like escarpments descending to the valley floor. The floor of the valley may be cut up into a large number of narrow blocks, with many small escarpments, as if the floor of the valley had

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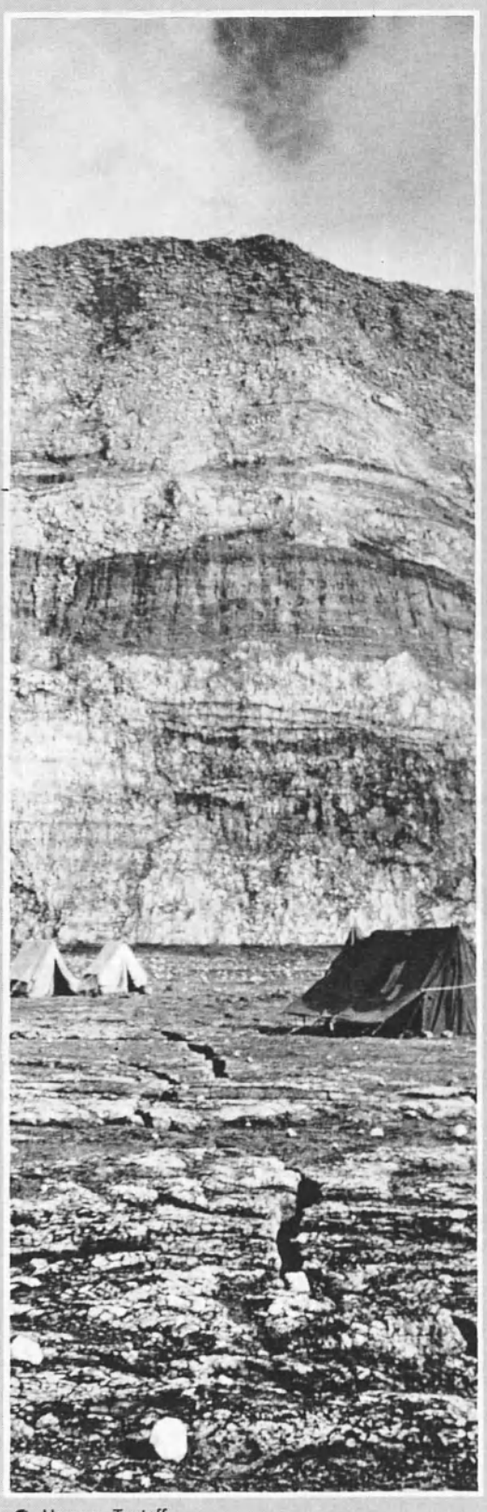
DESCENT FIERY PIT



© Haroun Tazieff

The expedition which explored Niragongo set up its camp on the higher of two terraces which overlook the central well of the crater. This terrace is surmounted by a vertical wall 180 metres (600 ft.) high (above). Two hundred metres (650 ft.) below this terrace a narrow platform encircles the vast molten lava lake (right). This great expanse of molten rock, sometimes calm and sometimes whipped into whirlpools and fountains of lava, awed even the most experienced members of the party.

The only lake of permanently molten lava in the world is the deep Niragongo crater, a volcano situated to the north of Lake Kivu (Democratic Republic of the Congo). In this area alone there are eight active volcanoes. Their presence and the existence of a zone of earthquake activity show that further movement and volcanic activity can be expected along the great African rift valleys. The 1,100-metre (3,600 ft.) wide Niragongo crater is difficult of access,

INTO THE

and involves climbing a mountain almost 3,600-metres (12,000 feet) high. The molten lava lake, covering 13,000 square metres (140,000 sq. ft.), is situated in a deep well overhung by a vast ring-shaped terrace (see the Unesco Courier, Oct., 1963). The crater was first explored in 1958 by an expedition of Belgian, French and Japanese geophysicists and volcanologists. Right, Haroun Tazieff, leader of the expedition, descends into the crater on the end of a cable.

Geyser power and minerals in plenty

broken into narrow strips along vertical fractures. In some places the valley is occupied by large volcanoes, lakes, or spreads of lake sediment. In the Red Sea sector the valley is underwater.

The highlands adjacent to the rift valleys are commonly broad plateaux areas composed of lava, but high ranges like the Ruwenzori mountains of Western Uganda, and the Cherangani range of Kenya are blocks of ancient rocks which have been pushed up to heights in excess of 4,300 metres and 3,400 metres (14,000 and 11,000 feet) respectively during the formation of the rift valley. Other high mountains, which occur mainly on the flanks of the valley, are the great volcanoes such as Kilimanjaro (5,900 metres; 19,300 ft.), Mt. Kenya (5,200 metres; 17,050 ft.), and Mt. Elgon (4,300 metres; 14,100 ft.), and the Aberdare Range (4,000 metres; 13,100 ft.).

It can be deduced that the original land surface has been lowered to below sea-level in the lower parts of the rift valleys, and the total relative displacement reaches to between 3,000-4,500 metres (10,000-15,000 feet) in some areas.

Broadly, the movements of the earth's crust during the formation of the rift valleys were a general bulging or up-lifting of wide areas, with the rift valley traversing the up-lifted areas as a strip of country which appears to have collapsed (or been dragged downwards) in relation to the general rise of the area. While the movements were in progress massive volcanic action took place in several areas, and continued almost to the present day.

The existence of a zone of earthquake activity along the rift valleys shows that the rifts are still active, and the widespread occurrence of very young volcanoes indicate that further movement and volcanic activity can be expected at any time.

In recognition of the importance of studying the African rift system in greater detail, a number of scientists met last year in Nairobi, Kenya, under the auspices of the International Upper Mantle Project and Unesco (1), to consider how to co-operate in further research. Scientists from several African countries agreed to take part in a programme aimed at producing an up-to-date account of the geology and geophysics of the rift system, and also to stimulate new research.

Subsequently the Upper Mantle Committee of the International Union of Geodesy and Geophysics established a Commission on the World Rift System, and the group concerned with the African rifts became one of its subcommissions. The first steps towards a programme of co-operation in geology and geophysics for the study of this most interesting feature of the African continent have been taken. Already some research is in progress, and other projects are being planned.

The existing knowledge of the African rift valleys shows that study of this structure is of more than purely academic interest. Associated with the rift system are a number of bodies of igneous rock derived from great depths which contain valuable metals such as columbium and the rare earths, which are of increasing importance in modern technology.

As a result of the internal drainage of the rift valleys and of their volcanic activity there are great saline accumulations such as the sodium carbonate and sodium chloride (salt) deposits of lakes Magadi and Natron, on the borders of Tanzania and Kenya, and the potash deposits of the Afar depression in Ethiopia. These deposits are among the largest in the world of these substances.

As a result of the very recent volcanic activity in parts of the rift system there are areas in which groundwater is heated. These geothermal areas contain numerous hot springs,

(1) The 34 scientists who took part came from Ethiopia, Kenya, Malawi, Uganda, Sudan, Tanzania, Zambia, U.S.A., Japan, U.S.S.R., Belgium, and U.K.

geysers, steam jets and gas jets, and it is possible that geothermal steam or gas can be tapped in some of these areas as a means of generating electricity. Some preliminary investigations of this possibility have already been carried out in Uganda and Kenya, and these potential energy sources are of great interest because the cost of electricity generated from geothermal steam is normally less than that from conventional fuels.

Although there have been few destructive earthquakes in the rift zone, it is recognized that there is a potential hazard from earth tremors (2). Studies of the nature and distribution of the earthquake activity are indicated to determine the areas likely to be affected. It is also desirable to establish codes of building construction that will minimize damage in the event of destructive earthquakes taking place.

It is very encouraging that scientists in some African countries can participate in the International Upper Mantle Project, and that they are contributing to the solution of one of the major problems of the nature and development of the earth's crust.

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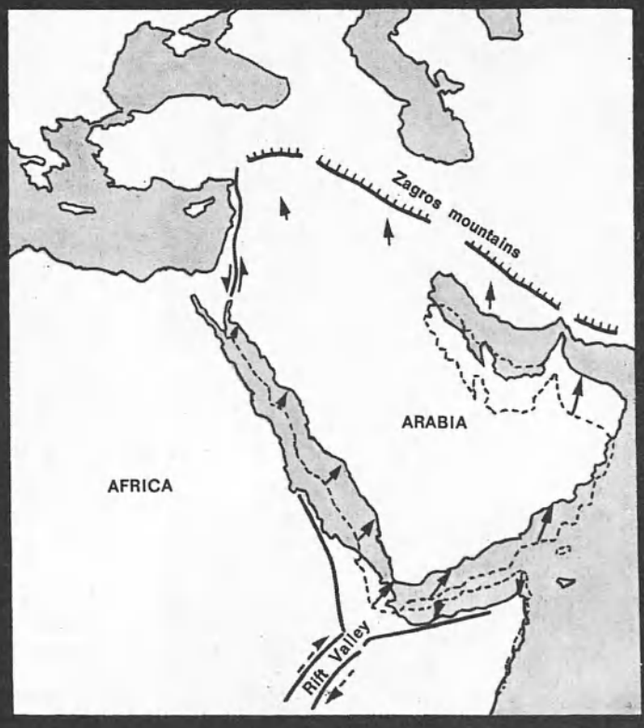
(2) A severe earthquake did in fact occur in Uganda on March 20, 1966, causing 100 deaths and widespread damage.

Hundreds of thousands of pink flamingoes grace the waters of Lake Nakuru (Kenya) which has now become one of the country's national parks. Although this lake has not been formed in a crater, it is surrounded by volcanoes and its waters are heavily impregnated with salts.

Unesco-Alain Gille

Is Arabia drifting slowly to the north-east?

A vast underwater mountain range estimated at 40,000 miles (64,000 kilometres) in length, several hundred miles in width and often 10 to 15,000 feet (3,000 to 5,000 metres) high encircles our planet, mainly in mid-ocean, but also meeting the continents in western North America, the Gulf of Aden and northern Siberia. Part of this ridge comes down the Atlantic, turns around Africa and runs through the Indian Ocean into the Arabian Sea, after which, via the Gulf of Aden, it invades Africa along the Great Rift Valley (see map above). If, as some scientists believe, the continents have drifted slowly apart during geological time under the impulsion of convection currents coming from deep within the earth's mantle and if the mid-oceanic ridges are the zones along which the rupture of the original super-continent took place, then the African rift system may actually be an early stage in the break up of the African continent. If, as has also been suggested, Arabia is moving slowly in a north-easterly direction, a new ocean basin may be forming in the area of the Gulf of Aden and the Red Sea (see map below). Some scientists foresee that millions of years hence parts of Africa may become detached islands, like Madagascar is today.



Recent geophysical research has produced new data in support of the theory that the Red Sea and the Gulf of Aden were formed by the gradual drifting of Arabia towards the North-east, and that this movement is still going on at the rate of about two centimetres a year. Direction and distance of movement of different parts of Arabia are indicated by arrows. Dotted lines show Arabia's original coastline positions.

From "New Scientist", January 27, 1966

A royal necropolis hidden for 3,000 years is unearthed in Iran

MASTERPIECES FROM A LOST

by
Ezat O. Negahban

Humped bulls stand in the tomb from which they have just been excavated on the rocky hillside of Marlik (above).

Photos © Ezat O. Negahban, Teheran

AMLASH, a town on the Caspian Sea, in northern Iran, has long been a centre for traffic in artefacts of inestimable archaeological value plundered from sites in the highlands of the Elborz mountains. Objects in pottery and bronze, silver and gold, stealthily excavated and taken to Amlash, have found ready buyers among antique dealers, and have later been resold in Teheran, Iran's capital, and abroad. This illegal trading in cultural treasures has been going on for so long and has reached such proportions that merchandise of this kind is now called "Amlash."

Iran's archaeological authorities, anxious to put a stop to this illegal and harmful traffic, decided that a necessary first step would be to carry out a thorough archaeological survey. As part of a survey of the entire country, work was begun late in 1961 in the Rahmatabad of Rudbar area of the province of Gilan. We chose this area because we knew it was one of great potential archaeological wealth, but about which little was definitely known. It was thus that we brought to light historical remains of the long-forgotten Kingdom of Marlik, dating back over 3,000 years.

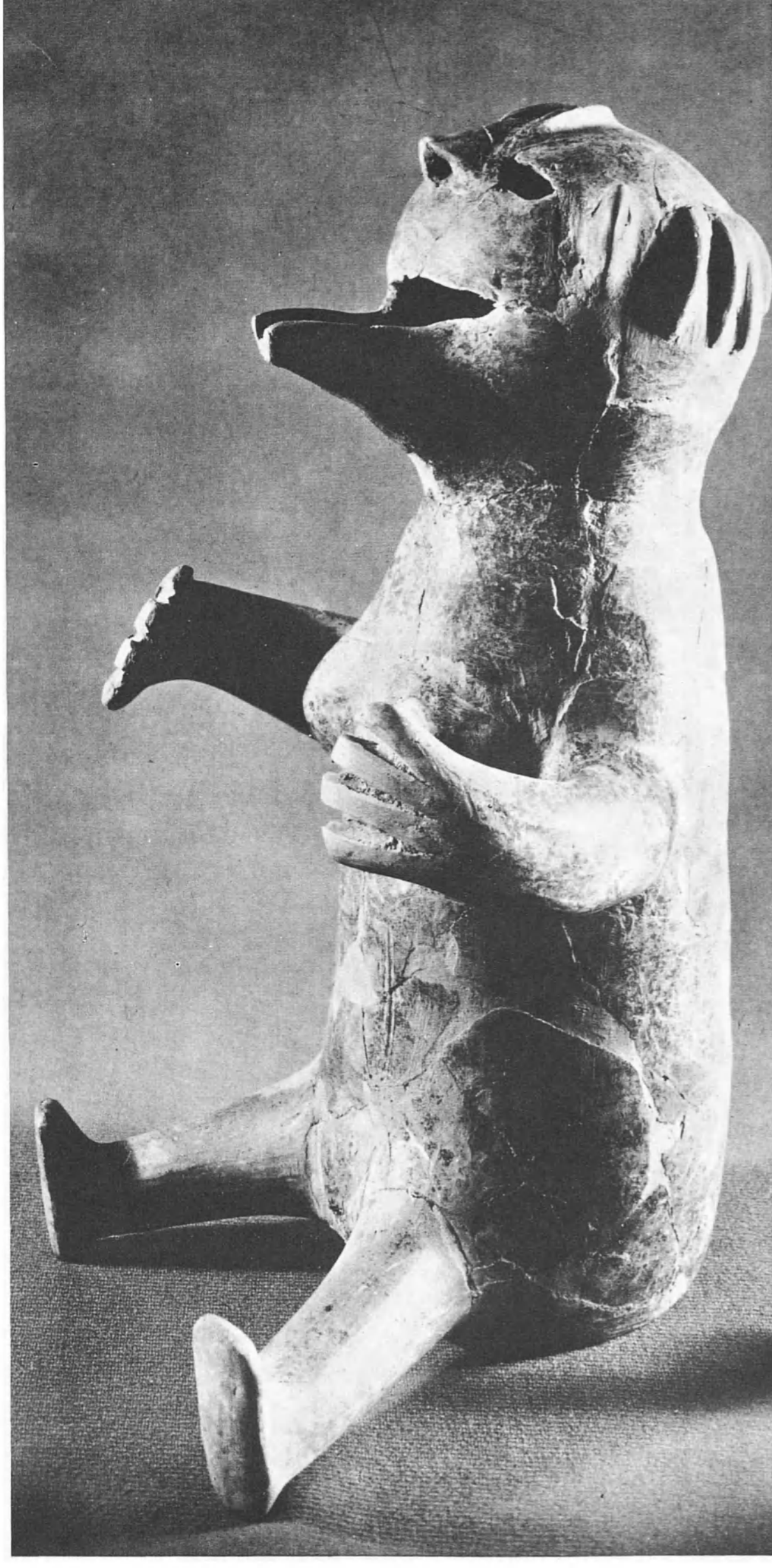
After several weeks, during which we investigated many ancient mounds and dug test trenches in those which did not have sufficient surface remains for identification, we entered the Gohar Rud Valley, a rich green land of rice paddies and wheat fields, dotted with groves of olive and wild pomegranate trees. There, on a barren, rocky hillside called Marlik tepe (or Cheragh-Ali tepe, after its last owner) we dug another test trench, the twelfth of our survey.

The trench yielded, among other objects, two small bronze figurines of cows, two cylinder seals and fourteen gold buttons. A thorough excavation of the tepe was started and gradually we came to realize that what appeared to be simply a natural hill was a burial ground containing a fabulous treasure —the royal cemetery of Marlik.

In all 53 tombs were uncovered, dug into the crest of Marlik tepe by a people who had inhabited the surrounding territory for several hundred years during the late second and early first millenium B.C. These tombs constituted the only archaeological layer on the hill. Nothing lay above or below except for a few miscellaneous objects near the surface.

EZAT O. NEGAHBAN *is director of the Institute of Archaeology, University of Teheran. He has written a comprehensive account of the excavations at Marlik, "A Preliminary Report on Marlik Excavations. Gohar Rud Expedition, Rudbar 1961-62" (text in Persian and English), which has been published jointly by the Iranian Archaeological Service and the Institute of Archaeology, University of Iran.*

Male figure holding a long-spouted vessel to his chest (detail). Like most of the human figures in pottery found at Marlik, Iran, it has six toes on each foot.



Seated female bear in red pottery (27 cm.; 11 in.). The Marlik animal figures, are actually vases. They usually have pierced ears and a muzzle forming a spout.

Photos © Ezat O. Negahban, Teheran

KINGDOM

The people who built these tombs simply dug a hole, cleared the earth away from the bedrock and constructed the tomb walls of broken stone and mud mortar, incorporating the bedrock wherever possible. Any spaces left outside the walls were filled with dirt and rubble. After the body had been placed in the tomb with the accompanying funerary objects, it was covered with a brownish-red earth different from the natural soil of the mound. Yellowish stones, again different from the natural stone of the site, were placed irregularly over the burial chamber after it was filled.

Thus, when we reached such a heap of stone, we knew a tomb lay beneath, and when we struck the brownish-red earth, the funerary objects were close at hand.

A bewildering variety of objects had been placed in these roughly constructed tombs—from simple domestic utensils to elaborate ceremonial vessels. There were also decorative and ritual figurines, bronze weapons, personal jewellery, pottery of all kinds, pieces of textiles, cylinder and stamp seals, toys and gaming pieces, small models of various tools, and beautifully decorated bronze, silver and gold bowls.

The pottery at Marlik ranges from utilitarian objects to decorative vessels. Either red or gray and unpainted, it is sometimes burnished. Pots were

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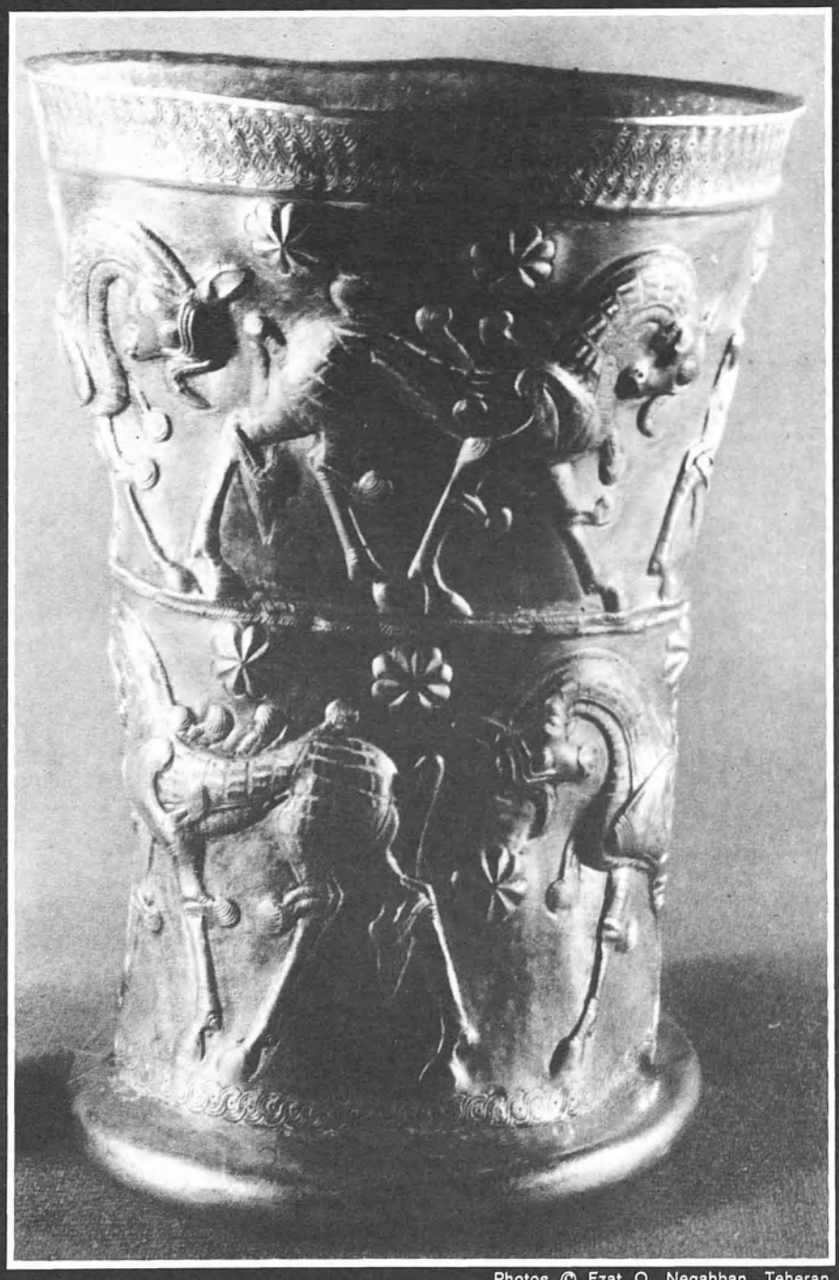
Detail of decoration on a silver vase (14 cm.; 5 1/2 in.) shows a warrior grasping a leopard by the throat. This is one the few illustrations of the dress worn by the Marlik people.

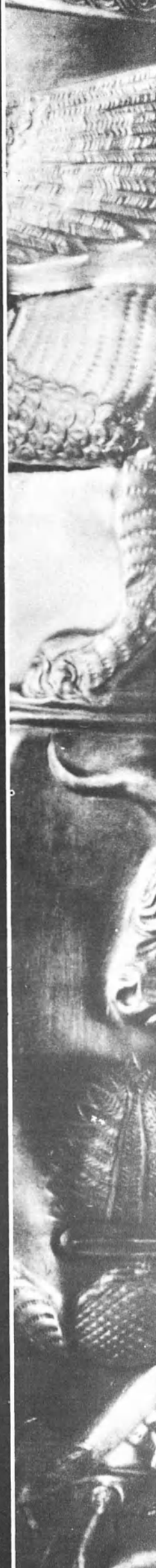


Photos © Ezat O. Negahban, Teheran

FASHIONED BY MASTER GOLDSMITHS

Left, two rows of gracefully prancing unicorns moving in opposite directions adorn this elegant gold vase (17 cm.; 7 in.). Many elaborate silver and gold vases were recovered from Marlik's royal cemetery. On some, the heads of animals are projected in high relief, almost in the round—one of the special techniques of Marlik's goldsmiths.

Right, griffins and, below them, winged bulls embellish this vase fashioned in gold. Both these fabulous monsters are ancient motifs of the Middle East, developed with distinction by the master artists of Marlik.



Several objects mounted on wheels, which may have been children's toys, were discovered at Marlik. Below, group figurine in polished, burnished red pottery depicts a charioteer, naked with a huge sword at his waist, standing between a pair of horses, the whole mounted on four wheels.

Far left, bronze figurine of crouching leopard (12 cm.; 5 in.) found in what was probably the tomb of a famous hunter. Centre, bronze figurine of a mountain goat with crescent horns and human feet mounted on three bronze rods (22 cm.; 9 in.). Left, grey pottery vase with long spout shaped in the form of a crane's neck and head (25 cm.; 10 in.).

Animal grace and vigour caught in clay

often decorated with impressed designs around the neck, shoulder or handle. One beautifully proportioned vase reproduces the graceful curve of a crane's head and neck, a bird still seen in the region. A motif based on the wild pomegranate is common.

The pottery animal figurines have a modern air because of their simple abstract shapes, and in addition they were functional, being for the most part hollow with the muzzles formed into a spout. Animals predominate, but there is also a charioteer, naked with a hugh sword at his waist, who stands between a team of horses, the whole mounted on four wheels. Several other objects on wheels may have been children's toys.

The pottery figurines representing human beings are notably cruder than the animal figurines, having flattened and distorted faces.

Animals were also depicted in bronze, but in greater numbers are the many weapons fashioned from this metal—spears, daggers, arrowheads, swords and maceheads. Among the replicas of tools and equipment are three models of hump-backed oxen with yoke and plough.

The variety and artistry of the jewellery and decorative objects is extraordinary. A beautiful gold bracelet has spiral butterfly beads and a pomegranate pendant. Among the pendants is a cage decorated with granulation, a double-headed eagle and a disk decorated with an abstract design.

The most magnificent of the objects found at Marlik are the gold ritual vessels—masterpieces of the goldsmith's art. One small gold cup depicts mountain goats at rest with their legs tucked under their bodies in the Scythian fashion. On two small gold bowls, decorated with eagles and rams, the heads of the creatures project from the body of the bowl in full relief, one of the special techniques perfected by the Marlik goldsmiths.

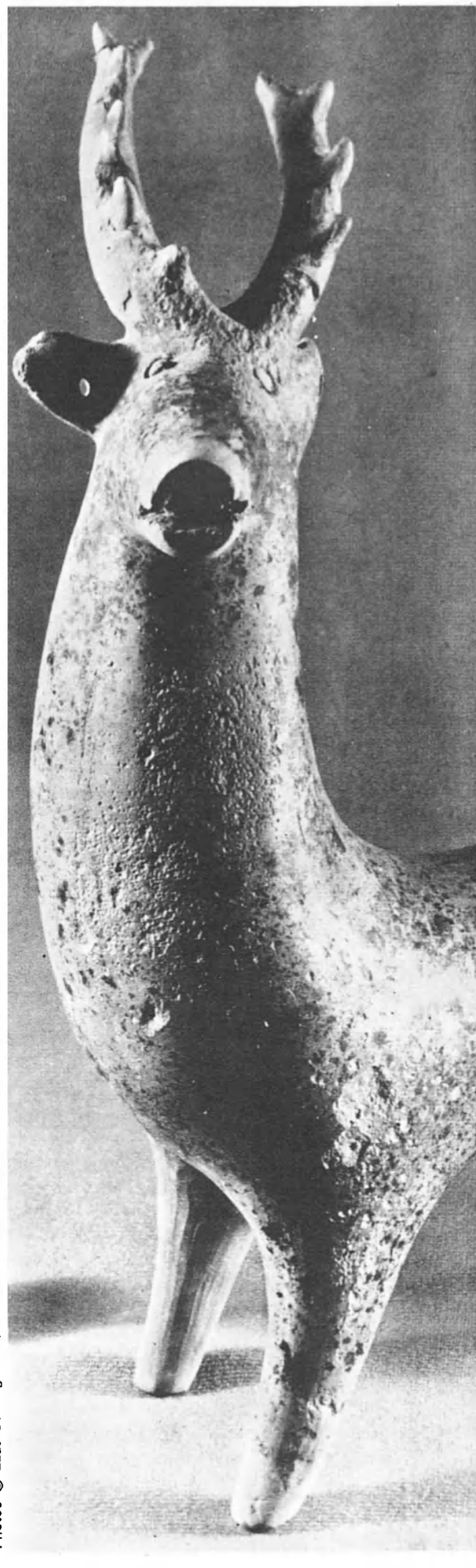
Unicorns, griffons and winged bulls are repeated motifs—all ancient symbols of the Middle East, and developed in a distinctive fashion by the master artists of Marlik.

On one tall gold beaker the life story of a mountain goat is portrayed. Four rows of decorations, in which the same motif is repeated around the body of the beaker, show a young kid being suckled by its mother, a young goat standing on its hind legs and eating from the Tree of Life, wild boars —apparently the enemy of the goat— and finally the carcass of the goat from which two large vultures are plucking the entrails.

A magnificent gold bowl, which we have called "The Marlik Bowl", is decorated with two pairs of winged bulls standing on each side of the tree of life. Their bodies are in profile and their heads in full relief, projecting outward from the body of the bowl almost two centimetres. The power and strength of the winged bull is beautifully expressed here in figurines full of vitality and life. This bowl is decorated on the bottom with a rosette, as are most of the Marlik gold bowls. Here the rosette represents the sun surrounded by the leaves of the Tree of Life.

We still have much to learn about the Marlik people—who they were, where they came from, where they went after the destruction of their kingdom. It is apparent that Marlik was the royal cemetery of a people who controlled extensive areas of northern and northwestern Iran 3,000 years ago. Their art clearly influenced much vaster areas. The period of the Marlik kingdom seems to begin toward the end of the traditional Mitannian art period and to end before the formation of the New Assyrian and Median powers. The influence of the Marlik artists on Urartian, New Assyrian, Median and Achaemenid art was extensive and long lasting.

It seems probable that the Marlik people and their culture played a direct and major role in the formative stages of the later empires of the Medes and the Achaemenids.



Photos © Ezat O. Negahban, Teheran

Detail of a burnished red pottery antelope with one pierced ear, its head turned gracefully to one side (28 cm.; 11 in.).

The latest kinds of teaching techniques put mathematics in the form of a language which describes the relations and interrelations among objects and sets of objects. One of the first steps is an exercise in reasoning. Here children learn to identify and to group objects on the basis of shape, volume and colour, and learn to recognize how they are related to one another.

WHY 1101 = 13

by Nicole Picard

Mathematics teaching is ceasing to be a series of formal and complicated drills through which children acquire the skills needed in solving examination problems. Increasingly, teachers and educational researchers are evolving and testing a kind of teaching that eschews learning by rote. Experience with these new techniques shows that not only arithmetical operations, but also fundamental concepts of mathematics can be learned intelligently by young children of primary school age. Last January an international group of specialists met in the Unesco Institute for Education in Hamburg, Federal Republic of Germany, to examine the results of recent research into the learning of mathematics by children aged six to 12. Below, a member of this group, Nicole Picard, describes some of the classroom and curriculum innovations of this new approach to mathematics.

THE urgent need for a new approach to the teaching of mathematics has gradually become evident over the past ten years to those responsible for education.

The advent of a scientific and technical civilization and its gradual extension throughout the world has brought far-reaching social changes, and in particular compulsory schooling. In the 1880s, education concerned children of six to ten years of age only; nowadays, in many countries that have reached a high degree of industrial development, it is compulsory for children of six to 14 or even 16. The basic objectives of education have also changed and urgent educational problems have arisen which now confront industrially-developed and developing countries alike.

As long ago as 1912 the distinguished British mathematician and philosopher Alfred North Whitehead wrote: "Before long science will be making spectacular new progress and for those who have not received an adequate education there will be no redress."

It is just as important to solve the problem of intellectual undernourishment as that of bodily undernourishment; indeed, it is only by solving the first problem that solutions will be found for the second.

NICOLE PICARD *is a specialist in research on mathematics teaching at the National Pedagogical Institute in Paris. She has written many studies on the introduction to mathematics in primary education.*

When the idea of compulsory schooling began to develop and spread about 1880, it was put into practice with great haste; everyone was to be taught to read, to write and spell correctly and to count, and the programmes were drawn up on that basis. In primary education mathematics was confined to the use of numbers. The pupil learned to do sums and solve arithmetical problems, but he was hardly ever called upon to use his judgment. Few children reached the stage where reflective thought is required, and those who did mostly came from the socially privileged classes.

Gradually, advances were made in technology. The horse-drawn vehicle was replaced by the railway, the car and the aeroplane. Distances diminished and contacts between different countries became easier. Nowadays networks for rapid communications cover the surface of the globe and even space itself has become a sphere of activity for man. Similarly, information is transmitted by more and more powerful means. The volume of knowledge within reach of each of us increases continuously; but in order to assimilate it, we need to develop faculties of reflective reasoning and critical appraisal.

Today technological development and increasing automation are gradually eliminating the employment of unskilled labour. By 1970 nearly half the working population of the industrialized countries will be composed of middle-ranking technicians and supervisory staffs. At the same time the need for more higher-level technicians and administrators is increasing.

Reading, writing and arithmetic are a far from adequate stock-in-trade for making one's way in our twentieth-century world. A person who has not received more than that has been intellectually starved.

The new patterns of economic growth and employment revealed the need to prolong compulsory schooling. The advantages of an educated community, in terms of national economic progress, became apparent, and higher education was therefore made accessible to an ever-larger number of students, especially those studying science and technology.

At the same time the content of teaching and teaching methods and aids have been changed. In mathematics in particular, the reform began at the top, in higher education. This was brought about by the vast accumulation of new scientific knowledge which revised many basic scientific concepts. Mathematical research became the main instrument for this revision.

In fact there should not be one kind of mathematics for school teaching and another for practical use. The basic core of mathematical reasoning and structures, together with their symbols, should be known to all. Detailed studies should follow in mathematical research and in other scientific fields—physics and chemistry obviously, as

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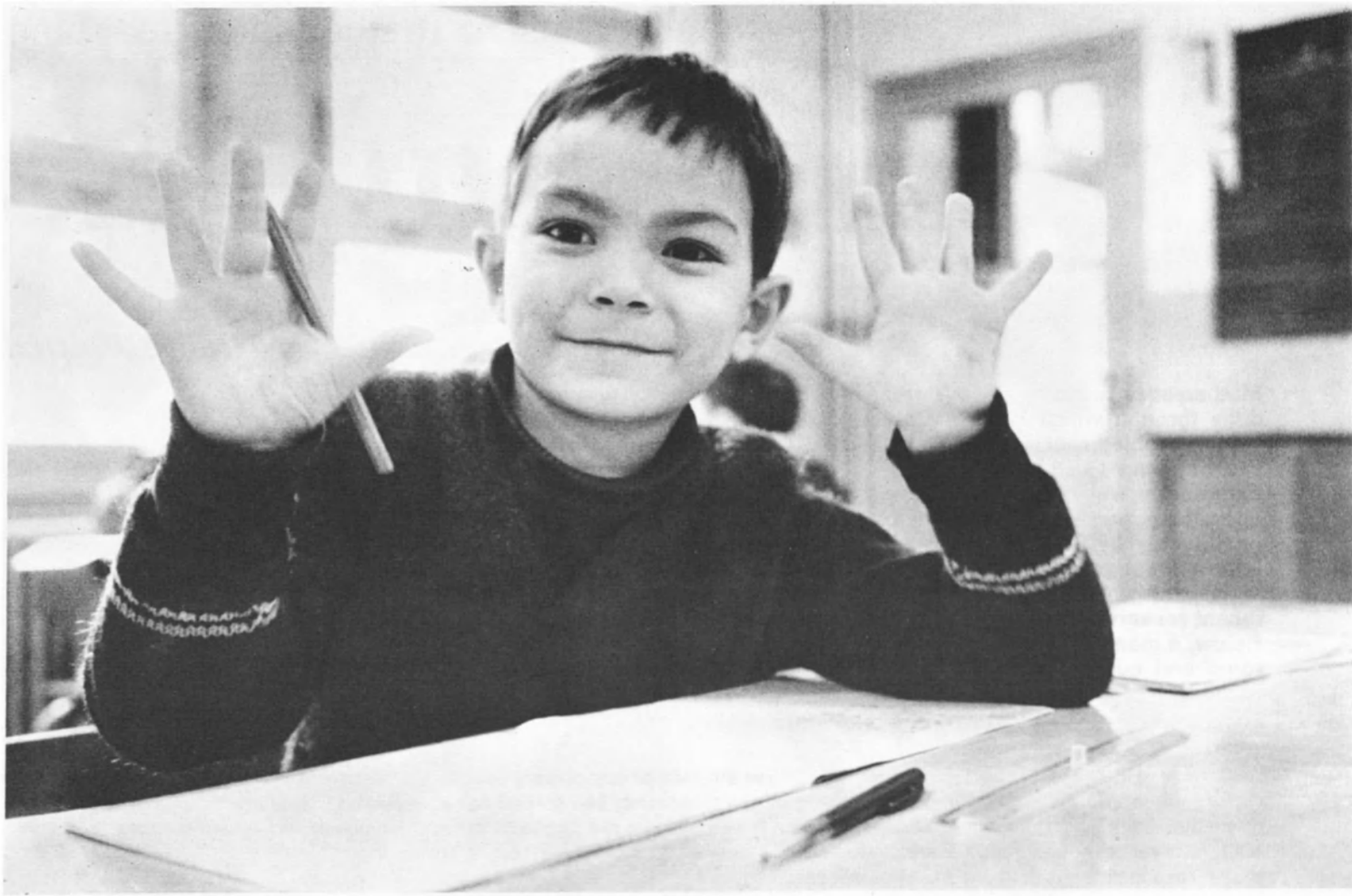


Replacing symbols, jargon and routine

well as medicine and psychology. Mathematics is also being increasingly used for research in sociology and history.

In the introductory teaching of mathematics, it is not just a matter of using the formulae of numerical calculation or the spatial ideas of Euclidean geometry. What is applied now in any field of learning, when we are attempting to organize new facts, is the mathematical language of structure, relations, functions and symbols.

This is sometimes called, "modern" mathematics. The new branch of mathematics, concerned with theories of sets and relations, which 20 years ago was reserved for a small number of research specialists, has become, in the last ten years or so, a subject for higher mathematical education. This evolution in mathematical studies has forced a reform in the mathematics curriculum at various levels.

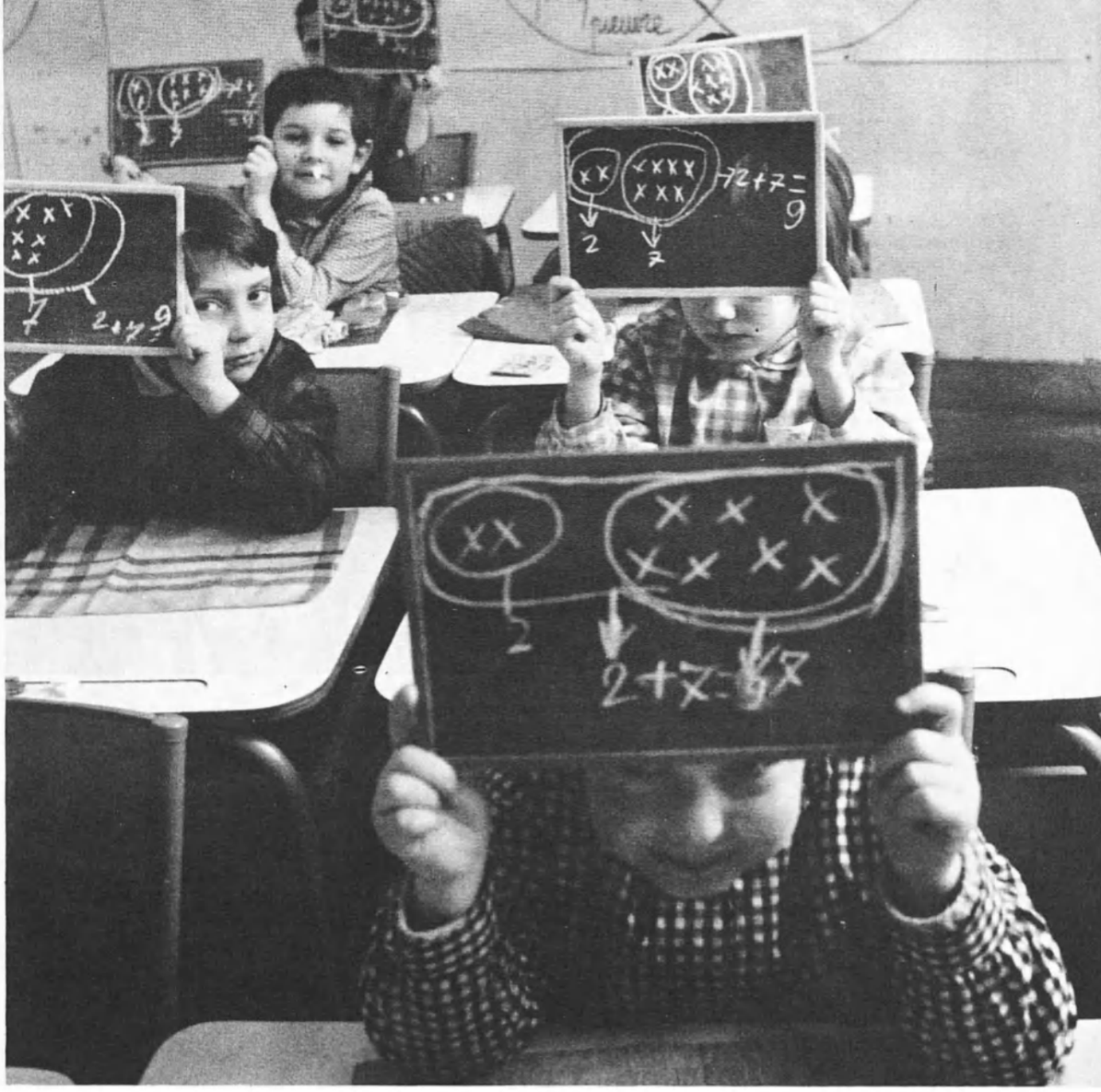
However the introduction of the new mathematics created serious problems. Teachers noted that because what they were explaining was so completely new, their students were not able to take it in and benefit from it unless their minds were first "de-conditioned." They needed to acquire a new way of thinking; the old mathematical frame was much too compartmentalized. It was obvious that training along the new lines must begin at the secondary level (12 to 16 years of age). Several groups were therefore set up to study the reform of mathematics teaching at this level. An interesting fact was that the groups included educational psychologists, logicians and specialists on problems of learning.

One of the many working groups of this kind is the International Commission for the Study and Improvement of Mathematics Teaching, which began its work in 1950. This group has used the method of international seminars: it has co-ordinated the work done in various places and has drawn up guidelines for further research.

It was observed, in the first place, that the reform of mathematics teaching could not be achieved unless it took root in the nursery school and extended to the university; secondly, that there was a very close connexion between initiation into mathematics and the development of the faculty of reasoning and intelligence; and lastly, that the revised subject matter demanded new teaching methods.

In countries where school attendance is compulsory up to at least 14, primary education is designed to lay solid foundations on which to build secondary education. Primary mathematical education should aim to provide a variety of experience. Concrete examples should serve as the basis from which it will be possible effectively to abstract (in the etymological sense, to "draw from") and generalize mathematical concepts. This should be possible from the ages of 12 to 16. In this way children will have had five years of experience in formulating ideas about mathematical structures. This learning will build the foundations of their mathematical knowledge.

Many programmes have been drawn up for this purpose. They differ in their approaches and also in the volume of their content. It seems clear now as a result of the work of child psychologists that from the age of seven, and not only from the age of 12 as was formerly thought, children are in fact capable of something more than merely memorizing calculation drills and acquiring routine skills.



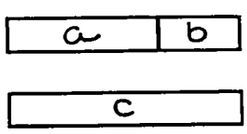
Right, the meaning of symbols. Exercises lead children from everyday things with which they are familiar to the abstract idea of numbers. They work first with elements that compose sets, then learn to recognize when sets have the same kind and number of elements. Association of equivalent sets then leads to the use of numerals to identify them. Left, fingers still come in handy for this boy to show the teacher that he has the right answer to the problem.

Photos © Institut Pédagogique National - Jean Suquet, Paris

In fact experience shows that from the age of seven children are capable of understanding mathematical shapes and sizes (provided they are sufficiently simple), and while playing with these concrete objects are able to deduce from the experience many mathematical relations. They can also solve practical problems, provided, of course, that the methods used are directly related to their sense of manipulation and tactile skill. They should be given a variety of materials to enable them to manipulate various forms of mathematical structures.

Of the methods used for the reform of mathematics education, those for arithmetic employ the most traditional approach. They consist in utilizing materials for manipulation that have the same structure as the ordinary numerical system. Instead of learning addition and multiplication tables by heart, children study addition and multiplication by an ordered arrangement of concrete elements.

Notable examples are the Cuisenaire rods and the blocks used by Catherine Stern. These were devised on the basis of the pioneering research of Maria Montessori. Arithmetical operations are represented by material arrangements to be performed by the children. Playing is, in itself, performing an operation: the action of putting bars together in line with the ends touching one another corresponds to the operation of "addition." Two bars *a* and *b* are equivalent to one bar c which has the same length as that obtained by putting the bars *a* and *b* together end to end:



If we symbolize the placing end to end by +, we have a + b = c; b + a = c; in the same way that 2 + 3 = 5; 3 + 2 = 5.

A similar procedure can be used for discovering the properties of the multiplication of numbers. As a corollary, the fact that addition and subtraction are inverse operations can also be seen, as well as the relation between multiplication and division. These methods are in use in Belgium, Canada, the United Kingdom and Switzerland, and to some extent in France.

Let us take a look at numeration by position. According to one of the known principles of the psychology of intelligence, a concept is assimilated better when all the possible components are made to vary. In the case of numeration by position, this means in particular that we must vary the bases. When we write a number, we make use of a sign-position. Thus, in order to write 1966, we use the numbers 1, 9 and 6; however, in the "word" 1966 the first and the second "6" do not have the same significance.

Our sign-positions constitute an "alphabet," the meaning of each sign depending upon its place in the word. If our alphabet has ten signs we are using a system of numbers "with the base ten," if it has three signs, a system of numbers with the base three and so on. Electronic computers use the base two, the Babylonians used the base twelve, certain primitive peoples use the base five. In teaching this implies that instead of speaking only of units, tens, hundreds, thousands, etc., we shall speak of successive groups, based on a certain method (a numeration with the base 2, 3, or 5 for example, or of 10, as

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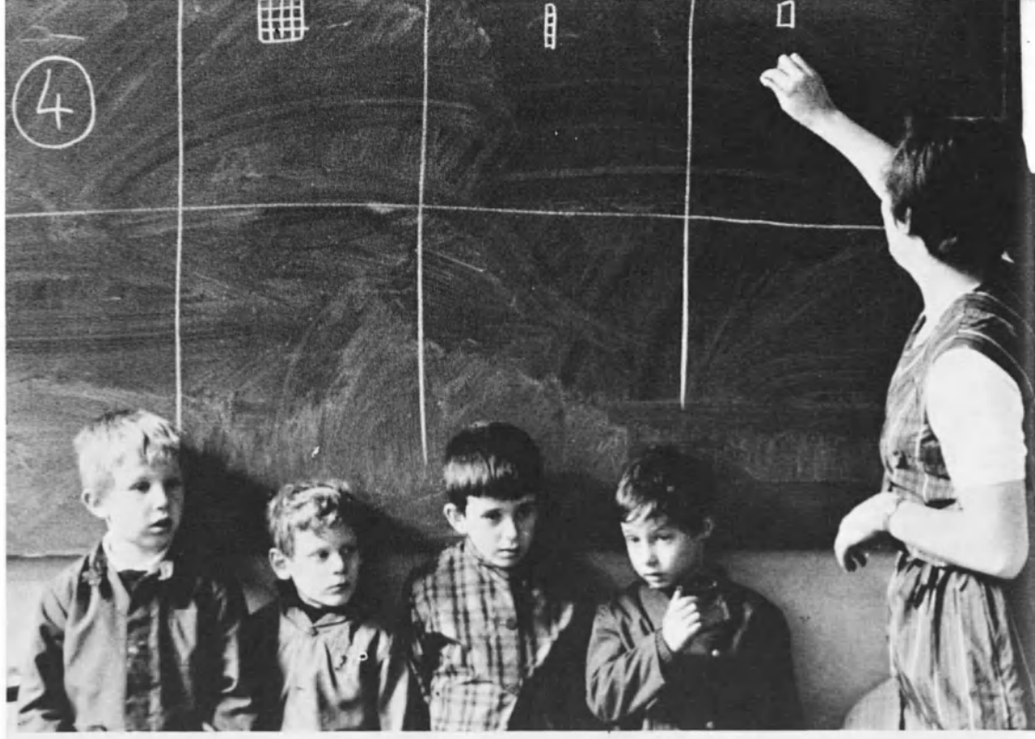
CONCRETE STEPS TO ABSTRACT CONCEPTS

As more purposeful mathematics teaching is introduced, children learn to count on other bases than that of the decimal system. Here a class learns how to calculate with a numbers system based on four. (1) The teacher gives each child a cube and divides the class into groups of four. (2) She calls each group in turn, takes their four cubes and gives in exchange to the group leader a rod which is four times bigger than a cube. (3) Calling out four group leaders at a time, she exchanges their rods for a single block that is four times bigger than a rod (or sixteen times bigger than a cube). All the children participate in these successive collections and exchanges of objects whose relative sizes correspond to the number base being used. Experience shows that by their second year in primary school, children are able to add, subtract, multiply and divide on any number base. They have not been taught these operations by rote but have discovered them experimentally.

Photos Unesco - Dominique Roger



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Children make their own discoveries

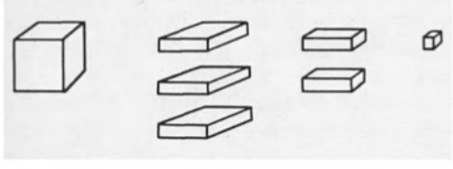
in the case of the decimal system).

From the time they begin to study numeration, children learn to count in terms of different bases: for this they use what are called Multibase Arithmetic Blocks.

If we say that we have 1 3 2 1 objects, that will mean that,

- with the base *four* we have $1.4^3 + 3.4^2 + 2.4^1 + 1.4^0$ objects;
- with the base *ten* we have $1.10^3 + 3.10^2 + 2.10^1 + 1.10^0$ objects,
- and with the base *n* ($n > 4$ as we have at least the signs 0, 1, 2, 3), $1.n^3 + 3.n^2 + 2.n^1 + 1.n^0$ objects.

In this equipment of blocks with base n, the power zero is represented by small cubes, the power one by a bar of n cubes, the power two by a plate of n bars of n cubes, the power three by a cube of n plates, the power four by a bar of n cubes of n plates, etc . . . so that our number 1 3 2 1 will be represented by the objects as follows:



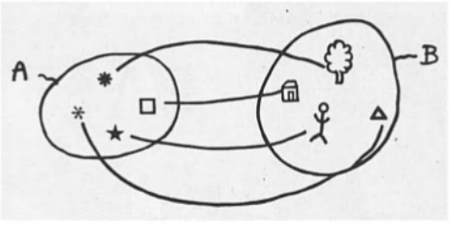
In this way children are led to make successive groupings and exchanges, following a model which varies according to the base used, the exchanges being imposed by the fact that, for example with four as the base, four plates must always be put together to make a cube.

From their second year of primary school, children are capable of performing the four arithmetical operations on any base. An interesting point is that the operational techniques are not learned, but discovered experimentally.

As regards methods based on the notion of sets, these necessitate much more extensive changes in the programmes than the previous method. They are based in particular on: (1) work involving the introduction of mathematical logic; (2) work in the sphere of psychology, concerning the evolution of the child's mental structure and his grasp of mathematical concepts.

The methods have in fact a much wider and more ambitious aim than giving an understanding of mathematics. Experiments made in the past few years indicate that where these methods have been used there are no longer any pupils good at literary subjects who are bad at mathematics. These same methods, which are based on notions of sets, operations with sets, and the logic of sets, do indeed help to develop a child's intelligence, by helping to organize his reasoning abilities. Experiments in the use of such methods were started this year with mentally retarded children but the results have not yet been assessed.

In these methods, an integral number is considered as a property of a set. The notions of set and property are thus fundamental ones, and the notion of number is built upon them.



Two sets, A and B, have the same cardinal number (that is, the same number of elements) when their elements can be put into one-to-one correspondence with each other.

The two sets A and B have a common property, namely that they each have four elements.

As we have said, before even talking of number the children "manipulate" the notions of set and property. A set can be defined either in terms of its extension—by enumerating all its elements once and once only; or in terms of what it comprises—by defining the elements of the set by a common property characteristic of them (all the children in the class wearing a blue pullover for example). Two sets are equal if and only if they are composed of the same elements: thus, if A is the set of even numbers above 1 and below 10 and if B = (2, 4, 6, 8), then A = B.

Notions of the property of an object gradually lead to the notion of the property of a set. Operations with sets provide the introduction to operations with numbers. In addition, the intuitive study of sets does not merely have the utilitarian purpose of introducing the child to numbers, but gives him, at a very early age, an initiation into the logic essential to organized thought.

Studies of the mental development of the child have shown that children of the same age differ vastly according to their social origin. Many children have not been able to get from their family background the cultural complement necessary to the full flowering of their intelligence. The new teaching methods involve notions of sets, operations with sets and also the fundamental notions of relations that are indissolubly associated with them. They thus give children, from their nursery school days, habits of classification, order and comparison. This offers each child the possibility of developing his own faculties to the maximum.

In fact these methods are meant to be introduced at the nursery school stage in the form of games and manipulations. This has been done mainly in England, France, Belgium, Northern Europe and the U.S.A.

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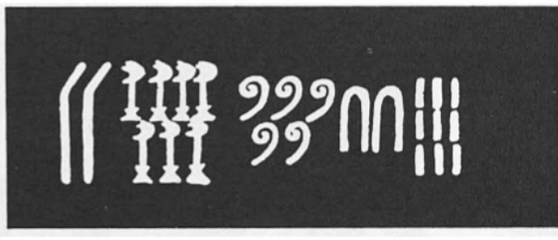
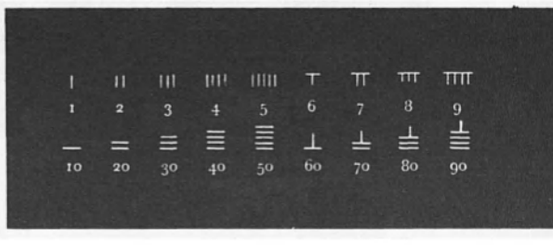
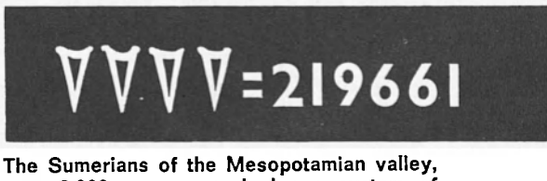


To keep their records of trade and government administration the Egyptians needed large numbers 5,000 or more years ago. So they made up a set of numerals by which they could express numbers of different values from units up to hundreds of thousands. Above, the number 27,529 as written by the early Egyptians.



Among the oldest systems of numerals are those used by the Chinese, and later adopted by the Japanese. These have naturally changed somewhat in the course of the centuries. One type (shown above) is based on the use of sticks laid upon a table and used for calculating. It was also used in written documents.



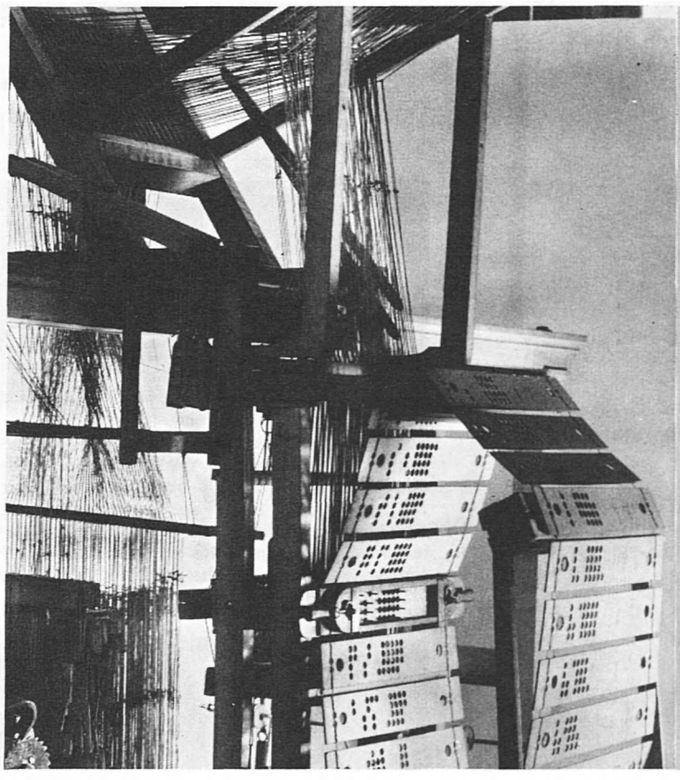
The Sumerians of the Mesopotamian valley, over 3,000 years ago, had one system of calculating for everyday use and another which was taught in special schools and used exclusively in texts on mathematics and astronomy. Cuneiform, or wedge-shaped, numerals were adopted for both systems. In the "scientific" system, the value of each numeral, starting from the left, is sixty times that of its neighbour on the right. Thus the cuneiform numerals above signify 216,000 + 3,600 + 60 + 1 = 219,661.

CAN YOU SOLVE THE PROBLEM OF THE CHINESE NECKLACE ?

Since ancient times the Chinese have shown a pronounced taste for mathematical games and puzzles. Here is an extremely simple example. We invite readers to try their hand at it.

During a long journey a merchant takes a room at an inn. His pockets are empty but he expects a messenger to arrive with money in 63 days. The innkeeper, however, insists on being paid for the lodging every day. The merchant has a necklace of 63 pearls and he proposes to use these pearls to settle what he owes from day to day. The innkeeper agrees to this arrangement and they fix the value of one day's bed and board at one pearl. When the messenger arrives, the merchant will settle his bill with the money he receives, take back his pearls and restring the necklace. To do this he is anxious to make as few cuts in the necklace as possible. While paying the innkeeper exactly what he owes each day, what are the smallest number of cuts he will need to make in the necklace?

The answer will be published next month.



© IBM

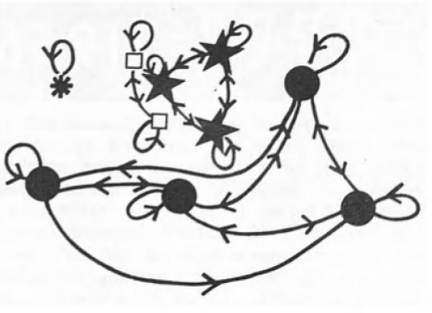
BASE 2 : 1101 = 13

$(1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) = 13$

Notation on the decimal scale, which originated in the number of fingers on the hands, is by far the most widely used system. Certain peoples have made use of other notations, including one based on 20 (the Mayas) and the binary (using the base 2). Reference is made to the base 2 in a Chinese book believed to have been written about 3000 B.C. Paradoxically it is the system used by ultra-modern electronic computers. The binary scale employs only two symbols: 0 and 1 and the digits represent powers of 2. Its importance is in relation to the use of perforated cards in computers. Since it has only two digits any number can be represented by a series of switches which are either "on" for one or "off" for nought. The use of perforated cards dates back well over a century and a half when the French engineer, Joseph Jacquard, perfected an attachment for the power loom in which a chain of punched cards passed before the needles of the loom (left). Only the needles facing the holes are able to carry out the process of weaving.

WHY 1101 = 13 *(Continued)*

In mathematics, the notion of "relations" cannot be dissociated from that of sets. A relation can be represented by a "diagram". Thus, if we represent by $\rightarrow$—— the relation "having the same shape as" between cut-outs stuck onto a sheet of paper, we get the following "diagram":



Experience shows that from the age of six, children are capable of representing non-oriented relations (a dash instead of an arrow). Reflexivity (each element is of the same form as itself) as a concept is still too subtle for them, but at the age of eight it can be understood without difficulty.

The importance of "representations" (graphs, plans, diagrams, tables) is that they enable the child to express in pictures what he would be completely incapable of expressing in words. In schools where teaching methods based on representations of this kind have been tried out, it has been found that not only are the children capable from the age of six of making their own diagrams; they also draw conclusions from them and thus make a first attempt at reasoning. This is interesting not only in pedagogy but also from the viewpoint of studying a child's way of thinking and powers of reasoning.

The study of relations from earliest schooldays has been tried out in Belgium and France with very interesting results.

A situation can easily be mathematicized if it can be expressed in a form directly accessible to logical reasoning. This procedure has been tried out in the countries mentioned above and also in the U.S.S.R., where some interesting research has been done.

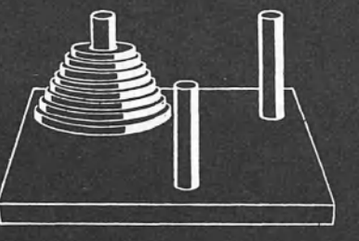
Experience has shown that algebra can be introduced into the curriculum from the age of eight—provided that concrete materials which can be manipulated are used. In fact it makes possible a great saving of mental recapitulation. For the solution of problems traditionally set in the primary school, children find it much easier

© Giraudon, Paris

DURER'S MAGIC SQUARE

In Albrecht Dürer's famous engraving "Melancholia" (detail left), there appears a device about which more has been written than any other form of mathematical amusement: the "magic square". This consists of an array of numbers in a square which, when added up by rows, diagonals or columns, yield the same total. In Dürer's square the numbers are: 16, 3, 2, 13, 5, 10, 11, 8, 9, 6, 7, 12, 4, 15, 14, 1, and their sum is 34 in all directions. As a final refinement, the celebrated German artist has included the date of his work, 1514, in the bottom row.

THE TOWER OF HANOI



The Tower of Hanoi was invented by the French mathematician Edouard Lucas and sold as a toy in 1883. The problem is to transfer the tower of eight disks to either of the two vacant pegs in the fewest possible moves, moving one disk at a time and never placing a disk on top of a smaller one. The minimum number of moves required is expressed by the formula 2^n-1 (n being the number of disks). Thus three disks can be transferred in seven moves, four in 15, five in 31 and so on. To transfer the eight disks and rebuild the tower 255 moves are required. Proving that n disks in the Tower of Hanoi can be moved to another peg in 2^n-1 steps is an excellent exercise in mathematical induction.

to use simple forms of algebra than the complicated arithmetic they are normally taught.

It would obviously take too long to review all the research that is being done. Some relates to the introduction of geometry (this is being studied especially in Belgium, Canada, Italy and the U.S.A.); another branch deals mainly with simple experiments in mechanics and physics. Research, in fact, is going on in a great many countries including Denmark, Norway, Poland, Hungary, to name only four.

In the developing countries the problem of establishing a suitable system of education takes a different form, and is perhaps even more acute than in the industrialized countries.

The most urgent question facing educational authorities in developing countries is the definition of the role of education. Many of these countries now need to train a large number of teachers in the next few years. Undoubtedly this will involve great difficulties, but paradoxically, these countries have an advantage over the industrialized countries. They have to *train*, not to *re-train* their teachers. They do not have to face the problem of "deconditioning" hundreds of thousands of teachers who have become used to rigid and stereotyped methods.

The people responsible for education in these countries are generally very enthusiastic. They need to be given as much information as possible about the educational reforms we have been describing. This will ensure that from the outset the teaching of mathematics, which is also a factor in the development of intelligence, will become, not a conditioning to out-of-date techniques, but an opening of the mind and a development of aptitudes.

Moreover, as this new teaching proceeds on the experience of experiments with children, it can very well be adapted to different cultural backgrounds and related to the social context in which children and adults grow up.

Similarly, the study of science can also be made relevant to the actual living conditions of a particular community. In fact one can form mathematical structures and relations by deriving them from the study of other ordinary elements of concrete objects. Source material for this can be selected from a number of simple, everyday experiences.

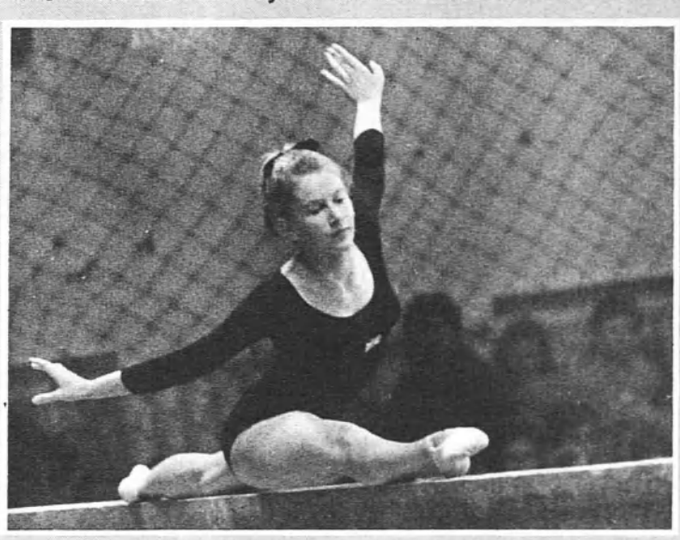
When sociologists and ethnologists make their contribution to the already promising research of the mathematicians, logicians and educational psychologists, even more fruitful results can be expected.

INTERNATIONAL TROPHIES FOR SPORTSMANSHIP

'Fair Play? Simply a question of honesty'

An athlete, a team of women gymnasts, a football referee and two football teams have been awarded the second annual International Fair Play Trophies (for 1965). These Unesco-sponsored awards are designed to honour men and women who place the highest values on a spirit of sportsmanship, even at the cost of losing a contest. Eugenio Monti, the Italian bobsleigh champion, who received the first of these awards last year, affirmed that the International Fair Play Trophy would become "the world's most coveted award." The committee which designates the winners is composed of representatives of Unesco, of the International Sporting Press Association, of the International Council of Physical Education and Sport and of leading international sports federations. On March 17, 1966, the latest winners of the Fair Play trophies were present at a ceremony in Unesco House (right) to receive their awards from Mr. J.E. Forbes, Unesco's Assistant Director-General, in the presence of M. François Misoffe, French Minister of Youth and Sports and of M. Jean Borotra (standing), France's veteran tennis champion, who heads the Fair Play Committee of the International Council for Education and Sport.

Unesco - Dominique Roger

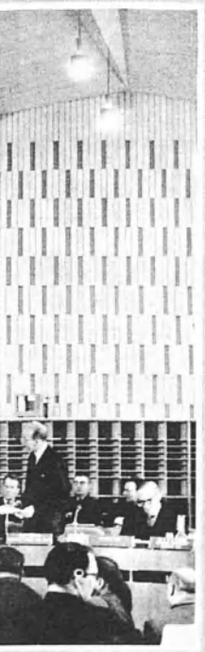


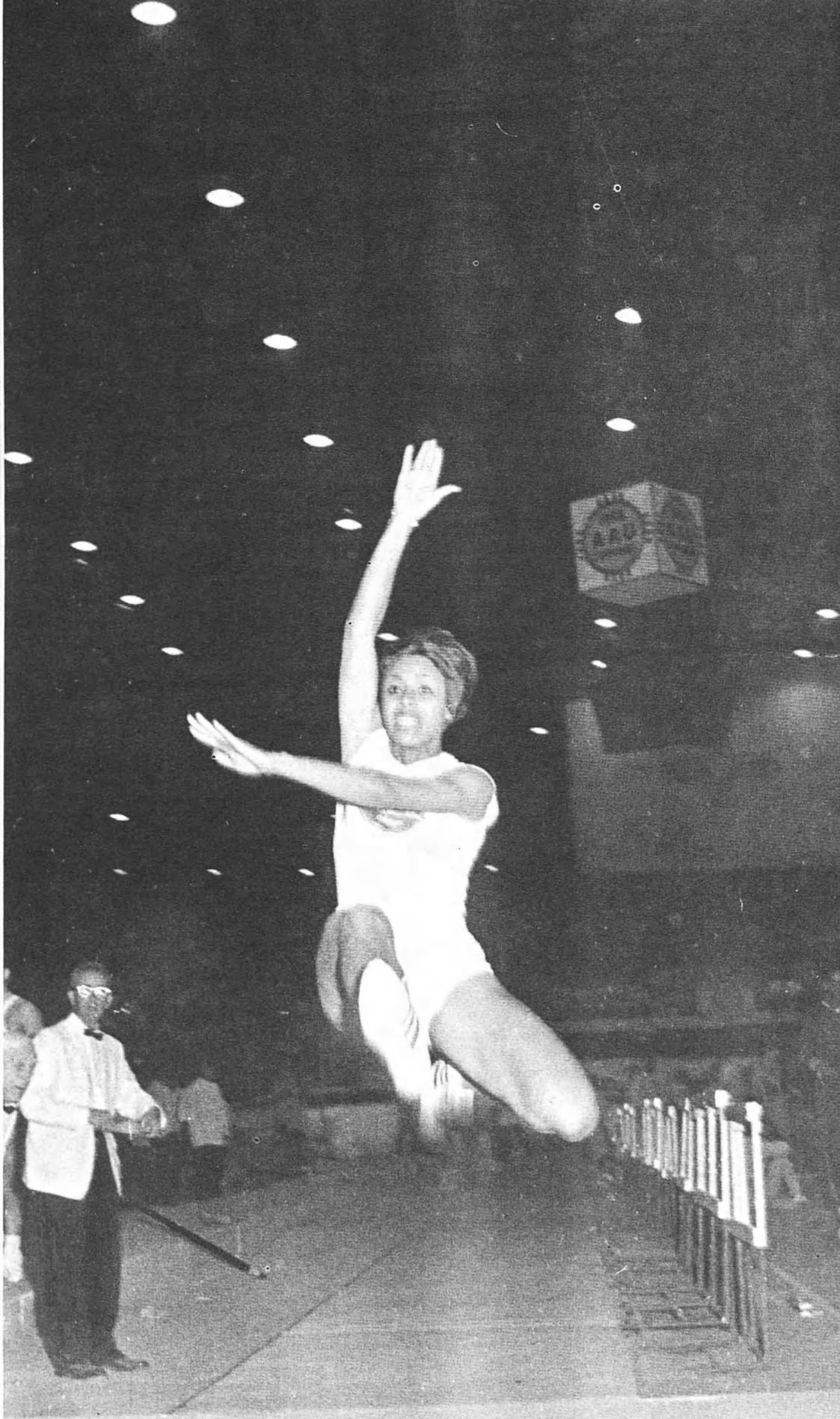
© Magyar Tavirati Iroda

In November 1965, the British Ladies Gymnastic team, about to meet a team in Hungary, heard that one of the Hungarians had been injured while training. Unanimously the British girls chose to withdraw one of their own members to even the chances—and the Hungarians won by a narrow margin. A Fair Play Trophy was presented to Mrs. Pauline Prestidge, coach of the British team. Left, her daughter, 16-year-old Mary Prestidge, a member of the British team.

© UPI, London

Some 80,000 fans packed the stands at Wembly Stadium, London, on May 19, 1965 to watch the finals of the European Cup Winners' Cup tournament (right) between the British team, West Ham United, and the German champions, the Munich 1960 club. The referee and the two captains, West Ham's Bobby Moore and Munich's Peter Radenkovic, all sensed that the enthusiasm and excitement of the crowd might easily turn into noisy demonstrations. But the match was played so cleanly and with such skill that the referee, Istvan Zsolt, of Hungary, was not obliged to award a single penalty. West Ham won, 2-0, but the newspapers of both countries were unanimous in praising the spirit of fair play shown by both teams. Captains and referee were presented with Fair Play trophies.





U.S. woman athlete, Willye White (right), silver medalist in the Olympic long jumps at Melbourne and Tokyo, has just beaten Mary Rand (above), British Olympic gold medal winner, her rival in the U.S. Amateur Athletic Union games in New York. To everyone's surprise, Mary Rand failed even to qualify for the finals. Discovering that the British athlete had mistaken some track markers unfamiliar to her, Willye White pursuaded officials to give Mary Rand another chance—whereupon the British girl went on to win the event. "Fair play", said Willye White, on receiving her Fair Play trophy, "is simply a question of honesty. Everybody wants to win, but nothing is won if an error made it possible."

From the Unesco Newsroom...

World Festival of Negro Arts

Flags of 40 nations flew over Dakar, Senegal, from March 30 to April 24, for the First World Festival of Negro Arts. More than a thousand performers took part in a programme which included displays of paintings, sculpture, literature, music and dancing. All Dakar's theatres and cinemas as well as its Parliament building were used for lectures and discussion groups, including a symposium on "the function and significance of Negro African art in popular culture," held under the sponsorship of Unesco and the African Society of Culture.

Spain offers fellowships in soil science & plant biology

An international training course in soil science and plant biology will be held, with Unesco's assistance, at the universities of Seville and Granada, Spain, from October 1966 to May 1967. Spain is offering full fellowships, including travel expenses, to selected participants. All lectures will be given in Spanish. For further details write to: Prof. Emilio Fernandez Galiano, Instituto Botanico A.J. Cavanilles, Plaza de Murillo 2, Madrid 14, Spain. Application forms must be returned by August 15, 1966

Food from leaves

A machine for extracting edible protein from the leaves of tropical plants has been designed and developed by a British scientist. Tropical leaves, which often contain as much as ten to twenty-five per cent protein, are crushed to produce a purée, and steam is used to curdle the protein which can be filtered off through cloth. About 500 pounds of leaves can be processed in two hours. A number of these protein-extracting machines are being used experimentally in India, New Guinea, Jamaica and Uganda.

Space phones in Australia

Western Australians may be making overseas telephone calls by satellite later this year because of U.S. plans to land men on the moon in Project Apollo. The Overseas Telecommunications Commission (Australia) will provide satellite communication channels and a ground station in Western Australia for use during the Apollo project. The station will communicate with two Early Bird type satellites which are being put in orbit over the Pacific and the Atlantic this year. Channels will be provided for both Project Apollo use and for Australian uses, giving the country its first commercial space communications link.

India to treble fertilizer production

As part of her plans to meet massive needs in food, India aims to treble her fertilizer production. India's newest fertilizer factory—the world's largest nitrophosphate plant—is at Trombay, 15 miles from Bombay. The factory, which went into production some months ago, is built on a 527-acre site and is designed to produce 320,000 tons of nitrophosphates a year. India's fertilizer consumption is still low—one kilogramme per acre compared with 27 kgs. in France and 95 kgs. in Japan.

SPECIAL DOUBLE ISSUE OF THE UNESCO COURIER FOR JULY-AUGUST 1966

The next issue of the Unesco Courier will commemorate Unesco's 20th anniversary and will include additional pages in full colour. Readers are asked to note that this special double number for July-August will appear at the end of July.

Educational problems of the Arab world

Ministers of Education and Ministers for Economic Planning of the Arab states recently met to study the educational problems of the Arab world at a conference convened by Unesco in Tripoli, Libya. Although the number of young people in the Arab countries receiving education has increased from eight to 12 million in the past five years, almost half the children aged from six to 11 still do not attend school. Overall gains, however, show that primary school enrollment is up from 6.3 to 9.8 million, of whom 35% are girls, and secondary enrollment is up from 1,124,000 to about two million, of whom 26% are girls.

BOOKSHELF

■ **Cultural and Social Anthropology: Selected Readings**

Edited by Peter B. Hammond. An introduction to the problems involved in the study of man. The Macmillan Company, New York; Collier-Macmillan Ltd., London, 1964 (30/-; $3.95).

■ **Industrialization and Society**

Edited by Bert F. Hoselitz and Wilbert E. Moore. The Social Implications of Industrialization and Technical Change. Unesco-Mouton, 1963 (42/6, $7.50; hardback).

■ **West African Urbanization**

By Kenneth Little. A study of voluntary associations in social change. Cambridge University Press, 1965 (35/-; $6.50).

■ **Geography of Coastal Deserts**

By Peveril Meigs (Arid Zone series; volume 28). Unesco, 1966 (33/-, $6.50; paper cover).

■ **World Guide to Science Information and Documentation Services** (bilingual: English-French).

Unesco, 1965 (13/-, $2.50, paper cover; 20/-, $4.00, hardback).

■ **15 Years and 150,000 Skills**

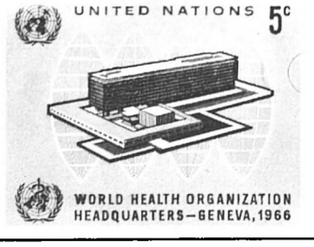
An anniversary review of the U.N. Expanded Programme of Technical Assistance, United Nations, New York, 1965 ($2.00 or equivalent in other currencies).

■ **Child Study**

By Norman J. Maynard. An introduction to educational psychology for teachers in Africa (Teachers' Library). Oxford University Press, 1966 (10/6).

New home for World Health Organization

A UN stamp issued on May 26 commemorates the opening of a new headquarters building in Geneva for the World Health Organization. Situated a stone's throw from the Palais des Nations, the new headquarters comprises an 11-storey Secretariat building, a cube-shaped meeting hall for the WHO Executive Board and a one-storey annex. The U.N. commemorative stamp is issued in denominations of 5-cents and 11-cents. As agent in France of the U.N. Postal Administration, Unesco's Philatelic Service stocks all U.N. stamps and first day covers currently on sale. For further details write to the Unesco Philatelic Service, Place de Fontenoy, Paris (7e).



New technique for reading fire-damaged manuscripts

Ancient papyri which have been so charred by fire as to be unreadable can now be deciphered thanks to a new technique developed by Dr. Anton Fackelmann, restorer at the National Library of Vienna. He uses an electrically charged plate to remove a thin layer from the papyrus, thus rendering the writing visible. Dr. Fackelmann also discovered how to unroll desiccated papyri by softening them with fresh papyrus sap. He also found the secret, lost in the Middle Ages, of making "Goldschlag parchment"—a very thin parchment treated with lime which was used to protect old papyrus from humidity.

Radiation energy for heating and cooling

Successful experiments in using solar radiation to heat houses and terrestrial radiation to produce spectacular drops in temperature are described in the Unesco quarterly "Impact" (Vol. XV, No 4, 1965; 4/-; $0.75). They are reported by Professor Felix Trombe, director of the French solar energy laboratory at Montlouis in the Pyrenees. At Montlouis prototype houses have been constructed to capture the sun's energy with built-in solar collectors and accumulator walls. These techniques have reduced the price of a solar kilowatt-hour to less than one-third of a U.S. cent. Professor Trombe writes: "House and water heating can be envisaged in cloudless countries where there are long periods of sunny cold weather... In warmer parts it is now possible to envisage applications of terrestial radiation that could improve living conditions and be used to preserve food."

Flashes...

■ *France is to establish a "National Institute of the Sea" at Brest, on the coast of Britanny, with places for 1,000 oceanography researchers, students and technicians.*

■ *More efficient diagnosis of atherosclerosis—the most common cause of coronary heart disease—will, it is hoped, result from a special WHO study in Czechoslovakia, Sweden and the Soviet Union.*

■ *Yugoslavia has become the 52nd country to join the Unesco-sponsored Universal Copyright Convention, which calls on countries to grant foreign works the same protection accorded to works by their own nationals.*

■ *A 70-year-old grandmother, Daw Thein, was among the 2,429 students who recently received their degrees from Rangoon University, Burma.*

■ *A new university, the 42nd in the Soviet Union, has been opened at Donetz in the Ukraine.*

'ONE DAY'S EXPENDITUDE ON ARMS'

A gift of $700,000 to be used in the fight against illiteracy has been made to Unesco by Iran. The gift was announced to the Unesco Executive Board, meeting in Paris on May 2, by Mr. René Maheu, Director-General of Unesco. Mr. Maheu read a letter he had received from the Shah, who explained that the contribution was "the equivalent of one day's expenditure under our military budget." The Shah's action follows the proposal he made to the Unesco-sponsored World Congress of Ministers of Education on the Eradication of Illiteracy, held in Teheran last September, that all nations should help to finance literacy by making small deductions from their military budgets. At a press conference in Unesco House on May 2, Mr. Fereydoun Hoveyda, Iranian Vice-Minister of Foreign Affairs, announced that the Shah had addressed a solemn appeal to all governments to make a special contribution to assist the struggle against illiteracy throughout the world. Mr. Hoveyda added that his country would be ready to repeat its donation if there were a favourable response to the Shah's appeal. Below we publish the text of the Shah's letter to Unesco :

You will remember that at the opening of the World Congress of Ministers of Education on the Eradication of Illiteracy, I said that, as many of the countries afflicted by this scourge have insufficient financial resources, international solidarity can and must come into play. Speaking of the possible sources of finance, I added that it would perhaps not be so very fanciful to ask the governments of the world to devote a negligible proportion of their military budgets to this great work. I also said that so far as we were concerned, we had made a national effort of this sort by setting up the Education Corps, and that we were ready to extend our efforts internationally for the good of all peoples.

I am now happy to tell you that as the Iranian year begins, with the budget just voted by Parliament, I have decided, in pursuance of the statement I made last September and of the recommendations of the Teheran Congress, to make available to Unesco the equivalent of one day's expenditure under our military budget, in order to assist in the struggle against illiteracy throughout the world. This represents a sum of about $700,000 drawn from the Iranian military budget for the year 1345 (1966-1967).

The eradication at the international level of the social evil of illiteracy naturally demands time and money on a far larger scale than that of my government's modest contribution. But it is to be hoped that this decision which, for a developing country like mine represents a real sacrifice, will be followed by many others and will perhaps enable Unesco to institute a special fund for carrying out an historic undertaking which is among those of greatest urgency for the economic, social and cultural development of mankind.

I am glad that the implementation of the recommendations of the Teheran Congress coincides, in 1966, with Unesco's twentieth anniversary that you will be celebrating in a few months' time. I take this opportunity of saying how heartily I desire that your Organization's efforts in the struggle against illiteracy, as in other important spheres of education, science and culture, may be crowned with success.

Letters to the Editor

OUR THIRSTY HUNGRY WORLD

Sir,

I read with great interest your March and April 1966 issues which covered ground very familiar to me. I was first engaged in hydrological work during the 1914-18 war when I organized and directed water supply activites in the Middle East, and I continued to work in this field after the war in much of Africa, Arabia and parts of India, where the people, in ignorance of ground water prospects and the means of its recovery, largely depended on ponded water and polluted streams for their domestic supplies. I thus experienced the conditions under which an explosion of population was endangering food supplies. I have also many times seen the distress caused by rain failure, pests and disease.

I have just renewed my subscription to the Unesco Courier for a further two years, and would like to say how much I enjoy reading every issue. I am about to enter my 94th year and am in semi-retirement, but I am still actively engaged in writing my memoirs which cover a period of 60 years, and include my experiences in petroleum exploration and oil-field development in all parts of the world.

A. Beeby-Thompson
London, England

WITH APOLOGIES TO ROSINANTE

Sir,

As a reader of the Courier for the past seven years I have learned to appreciate its qualities of reliability and interest. Reading the piece on Cervantes (Great Men, Great Events) in your March 1965 issue, I was surprised to find Don Quixote's nag described as a mare. Rosinante, of course, was a horse. Please restore to the famous mount of the Melancholy Knight its proper sex and rightful dignity. Bravo! for commemorating the anniversaries of great events and of the great men and women whose significance is universal.

Jacques Decamp
La Madeleine, France

JUNIOR OLYMPICS

Sir,

I am 14 years of age and an Australian. I know everyone enjoys and realizes the tremendous value of the modern Olympic Games. They must spread tremendous goodwill between the various competitors of different religions, races, colours and ideologies, but nevertheless all these competitors are generally mature adults who have firm opinions on most things of importance by the time they compete. Sometimes these opinions can be an obstacle to really close friendships with other people.

My idea is that there should be a Junior Olympic Games with children from all the nations entered in the real Olympic Games. What a wonderful way of promoting friendship, goodwill and physical fitness this would be. The Junior Games could be held every four years (as are the real Olympics) but in a different city. I think the idea has great possibilities and I wish someone could do something concrete about it.

I came across the Courier in our local library. I find it very interesting and intend to take out a subscription.

Gavan Keating
Ballarat, Australia

THREE CHILDREN EVERY SECOND

Sir,

The Unesco Courier is one of the outstanding voices of our time—a historic time of integration for the human family, a kind of new Renaissance in which all social structures are undergoing constant and decisive changes.

In this complex situation the population explosion has become Factor Number One, and your February 1966 issue rightly emphasizes this, starting with the front cover which tells us that two babies are born into the world every second.

This figure set me thinking. If we take 65 years as man's average lifespan, the annual global mortality rate is about 15.5 per thousand. This means that about 50 million of the world's 3,200 million inhabitants die each year. Since the total annual population increase in the world is 60 million, the total annual number of births must be around 110 million. And since there are approximately 31 million seconds in one year it seems to me that the correct figure must be 3.5 babies born every second. Am I right?

Alberto J. Scardiglia
Cordoba, Argentina

We agree with our reader that the figure of two children born every second is an overcautious estimate. Although global demographic figures are necessarily approximate (in many countries precise and up-to-date statistics are still not available) it would no doubt be more realistic to consider three births a second as the world average. It is the actual population increase that has now reached the rate of two people a second—a yearly total of 60 million—Editor.

THE OPPENHEIMER HOSPITAL

Sir,

I can confirm, as N. V. Baldwin states in the letter published in the December 1965 issue, that the picture shown on page 29 of the issue on Racialism (April 1965) is in fact the Oppenheimer Hospital at Welkom, some 185 miles from Johannesburg.

My knowledge of this is that I designed and planned the new town of Welkom.

In 1946 the late Sir Ernest Oppenheimer commissioned me to design the new town of Welcom and his instructions were that it should be not only an example of Good New Town Development in South Africa, but throughout the world.

The late Sir Ernest was very keen on the best conditions for all the inhabitants and desired to establish a permanent labour force for the gold mines, living in the town.

In his effort to do this he endeavoured to establish family life in the mining areas and the township for as many as possible of the permanent employees, instead of the normal migrant labour, which necessitated the men leaving their families.

Wm. O. Backhouse
Johannesburg, South Africa

YOUNG PEOPLE OF ISRAEL

Sir,

In your issue on Youth, bearing the symbol of International Co-operation Year, 1965, I was surprised that no mention was made of the young people of Israel. We have first-rate youth hostels; the international youth workers' service is doing valuable work in our country; our "higher technical school" has a world-wide reputation; we have youth clubs; our young people have done all kinds of pioneering work and, like youngsters in other countries, they are fascinated by every aspect of science. They deserved at least a mention because of some special characteristics. Our young people are composed of disparate and complex elements not easily combined into a single whole. They are the result of a distinctive mingling of different peoples; each has inherited characteristics of his country of origin, but all are determined to attain a new unity.

Mary Heimann
Kirjath Bialik, Israel

Imp. GEORGES LANG, PARIS. IMPRIMÉ EN FRANCE.

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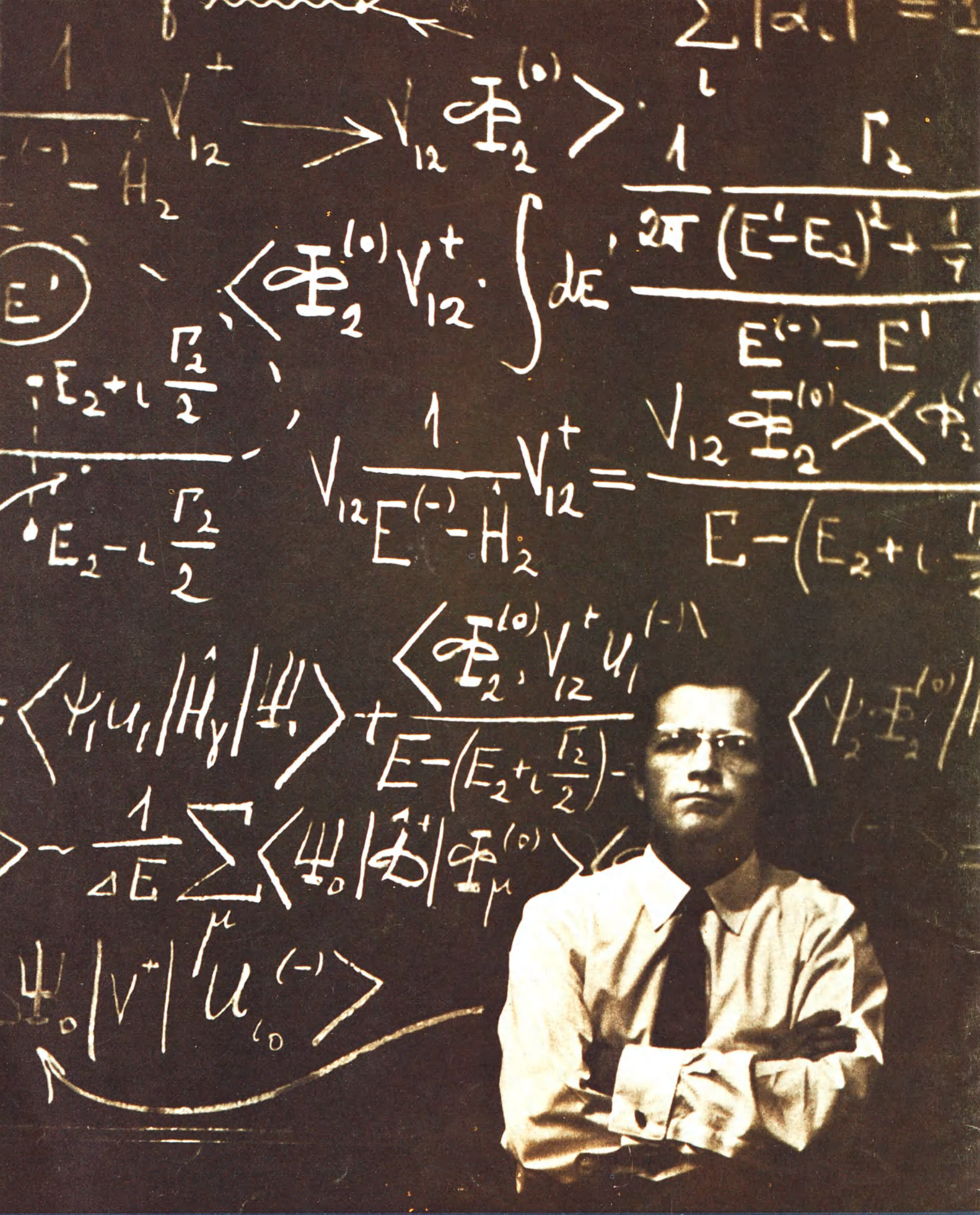

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NEW LOOK IN MATHEMATICS. Economic progress, in developed and developing countries alike, demands more and more engineers, scientists and teachers, and thus depends a great deal on the quality of school mathematics. Educationalists have been studying traditional teaching methods, and now propose a new approach to mathematics (see p. 22).