ARAMCO WORLD

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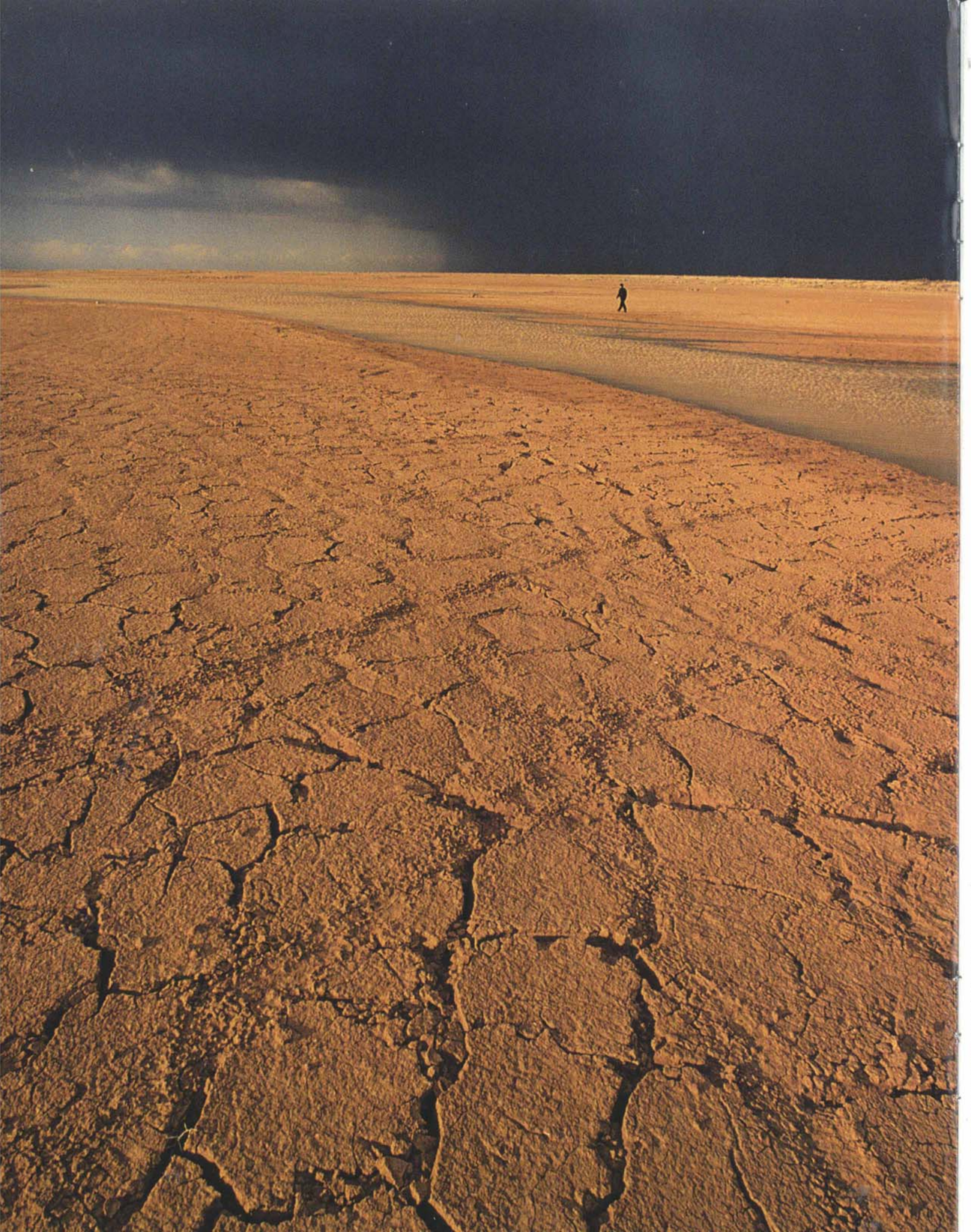
NOVEMBER/DECEMBER 1997



18 AND COVER: THE ROYAL COLLECTION, COPYRIGHT HER MAJESTY QUEEN ELIZABETH II

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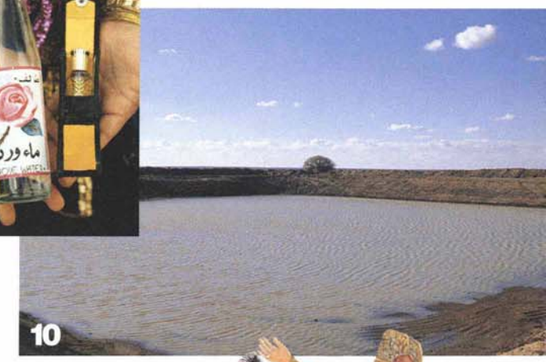

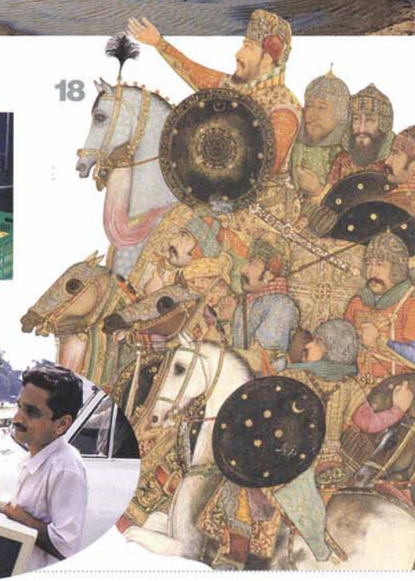

COVER:
A festive crowd of nobles and musicians gathers at the Mughal court in Agra, India, to celebrate the arrival of the three sons of the newly crowned Shah Jahan. Though produced more than a decade after the 1628 event that it records, the painting's figures are probably accurate portraits, as they are throughout the Padshahnamah. *The placement of each courtier in the composition reflects the rank and regard he enjoys.*

OPPOSITE:
Fickle winter rains may—or may not—turn these cracked, golden mudflats of Jordan's Badia into pasture. A researcher of the Badia Research and Development Program takes a soil sample. Photo by Tor Eigeland.

BACK COVER:
The oil-bearing damask rose cultivated in the Taif highlands came originally from Persia or India, via Bulgaria. Photo by Michael R. Hayward.

Saudi Aramco, the oil company born as a bold international enterprise more than half a century ago, distributes Aramco World *to increase cross-cultural understanding. The magazine's goal is to broaden knowledge of the culture of the Arab and Muslim worlds and the history, geography and economy of Saudi Arabia.* Aramco World *is distributed without charge, upon request, to a limited number of interested readers.*

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The Roses of Taif

EACH APRIL, SOME 2000 FARMS IN THE UPLANDS NEAR TAIF TURN PINK.

A single species of intensely perfumed, delicate pink flower annually transforms the rural communities of al-Hada ("Tranquility") and al-Shafa ("The Edge") into fragrant, roseate splendors. For three centuries, the oil-rich, 30-petal damask rose (*Rosa x Damascena trigintipetala*) has been cultivated here and processed into precious attar of roses and its popular—and even older—counterpart, rose water.

Blessed with a climate that makes it a refuge from the heat of nearby Jiddah and Makkah, the highland haven of Taif is one of Saudi Arabia's fruitbaskets, as well as a popular summer resort. West of the city, the land rises above 2000 meters (6400'), and it is here that favorable temperatures, plentiful groundwater, well-established irrigation systems and fine topsoil have combined to earn the region the name "Arabia's Rose," ever since roses began to be cultivated here in the Ottoman era.

The word *attar*, which is today a synonym for rose oil, comes from the Arabic *'itr*, meaning "perfume" or "essence." The first description of the distillation of rose petals was written by the ninth-century philosopher al-Kindi, and more sophisticated equipment was described in the 10th century by al-Razi (See *Aramco World*, May/June 1997); one of the earliest centers of rose-water production was in southern Persia. Later, in the 13th century, rose water was produced widely in Syria, and the name of the oil-bearing rose genus *Damascena* may trace its origins to the city of Damascus. But true attar—rose oil as we know it today—was not produced until the late 16th century, when the double-distillation technique was developed.

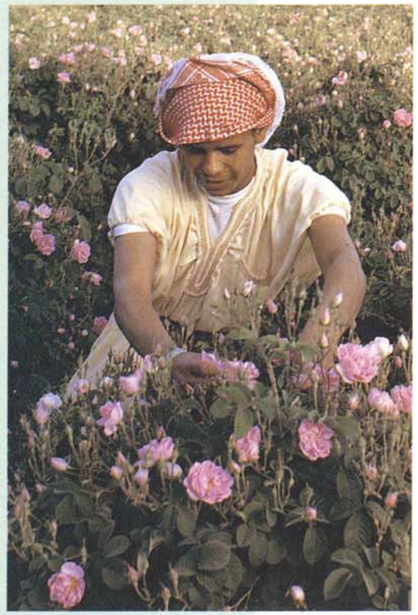
No one is certain how the 30-petal damask rose first came to Taif. The impulse for its cultivation, however, assuredly lay in Taif's proximity to Makkah. That the rose of Taif is virtually identical to the famous Bulgarian "kazanlık" strain suggests

that Taif's roses may have been transplanted from the Balkans by the Ottoman Turks, who occupied that area from the mid-14th century and the Hijaz from the 16th century. However, the kazanlık rose—its Turkish name means "suitable for the [distiller's] kettle"—has its own roots in the Persian rose plantations around Shiraz and Kashan, which in turn supplied fields in Syria. A legend among the growers of al-Hada says that the flower originally came from India.

Today, Taif's production, though high in quality, is modest when compared to the quantities produced by larger, export-oriented operations in Turkey, Bulgaria, Russia, China, India, Morocco and Iran. But the market is not oversupplied, for, now as always, attar is painstakingly obtained, and both its potency and its price remain so high that a gift of this precious oil is one of the highest compliments that can be paid to anyone.

In the early days, up to 200 years ago, Taif's rose petals were collected and sealed into sacks for transport by camel roughly 65 kilometers (39 mi) down to the holy city of Makkah. There, Indian pharmacists distilled attar from them, using a process not unlike that used today. These artisans became masters of one particularly fine type of attar that they produced by infusing rose distillate

WRITTEN AND PHOTOGRAPHED BY MICHAEL R. HAYWARD



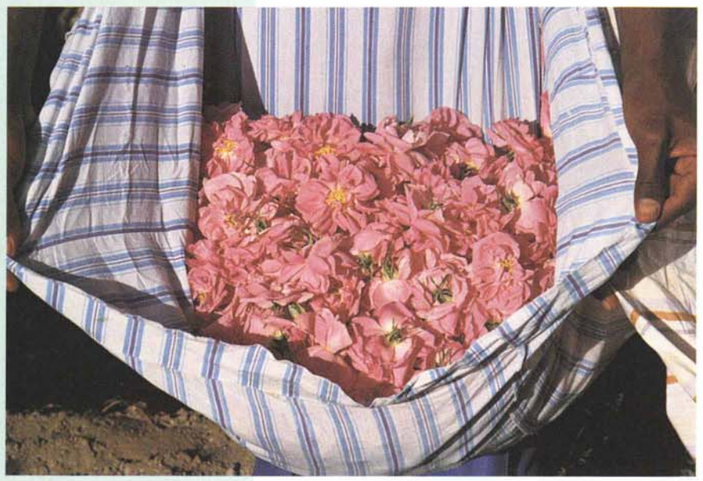
Throughout the April rose harvest, pickers rise early to pluck the blossoms just after they open and before the day's warmth evaporates their fragrant and volatile oil. ***Opposite:*** *Roomfuls of blossoms are distilled to produce minute quantities of precious attar, or rose oil, the most widely used ingredient in the world's commercial perfumes.*

into sandalwood oil, resulting in a blend with refreshing floral and woody notes. Interestingly, this blend can still be found in India, though it is now rare in the Saudi Arabian market.

About two centuries ago, the distillers brought their craft to Taif itself. Here, closer to the rose fields, the manufacture of rose oil was more efficient, because the volatile rose oils evaporate rapidly from harvested petals. Soon after the establishment of these distilleries, Taif rose oil began to win acclaim from all over the Muslim world. Any pilgrim who could afford it bought at least one vial—called a *tolah* for the weight of its contents—of the celebrated perfume as a souvenir of the Hajj. Pilgrims traveling overland from the east would often take the route through Taif specifically to purchase rose oil. To the present day, Taif rose oil is the variety preferred by the authorities of Makkah, where attar is used to perfume the the so-called Yemeni Corner of the holy Ka'bah in Makkah's Grand Mosque.

But while a well-stoppered bottle of attar endures for years, perhaps indefinitely, the glory of Taif's roses themselves is ephemeral. Their flowering lasts only the month of April, and each day's harvesting begins at dawn and is over by 7:00 a.m. But during this harvest, open any window in al-Hada or al-Shafa and savor the fragrance that permeates the still mountain air at daybreak. From any vantage point, vistas of pink unfold as the rising sun spills over the ridges.

For the pickers, there is no time to lose. Down in the fields, the light of the new day illuminates the early risers, baskets in hand, some still clad in nightshirts.



Collect an empty basket and join the bands of laborers, for rose growers on the region's nearly 2000 family-owned farms now need all the help they can muster. The pink, cupped blooms unfold only at dawn, and as the sun moves higher, the oils evaporate until, by midday, unpicked blossoms contain only about half the oil they had at daybreak.

At the peak of the crop, roughly the third week of April, an established bush, which can be head-high, could be topped with up to 200 roses each morning. A fully mature bush, perhaps 15 to 20 years old, heavily manured and judiciously pruned back each December, can produce more than 3000 roses during the season.

Once the picking basket is brimming with blossoms, damp and sparkling with dew, join the procession to one of the nearby distilleries. In al-Hada, one is owned by the al-Ghashmari clan who, passionately fond of perfume and flowers, still practice the craft of two-step distillation as it has been done for centuries.

Attar and rose water are produced using 120-liter (32 US gal) tin-lined copper boilers. Today they are heated by gas rather than by wood or, as they sometimes were, by smokeless and odorless cakes of camel dung. Into the copper boilers are poured about 50 liters (13 gal) of water and roughly 10,000 rose blossoms. This simple mixture is allowed to simmer gently for up to six hours. The steam is collected by an alembic, a mushroom-shaped helmet that fits tightly on the boiler and has a tube that angles down from the top. This tube directs the steam through a zinc cooling tank filled with tepid water. There, the distillate condenses and runs down into a large glass carboy, where it begins to separate into rose water and attar.

But the yield of attar from this first distillation is low, as most of the volatile oil is still dispersed in the rose water, which is known as *al-arus*, or "the bride." The *arus* must be redistilled, a process called cohobation. There are two types of cohobation: *arus* can either be poured onto a batch of freshly picked flowers—from which it dissolves a higher proportion of the volatile oils than hot water can—and then redistilled with care, avoiding excessive heat, or it can be distilled a second time on its own, again very slowly. Either method produces an enriched rose-water condensate called *al-thino* or "second cut." Once cohobation is complete and the product has cooled, there is great excitement as the richly-perfumed globules of attar coalesce and rise to the surface of the rose water. From there they are decanted. Only by the added effort and expense of cohobation can the highest yield of oil be obtained.

The freshly distilled attar is then allowed to stand for several days to permit impurities and colloidal matter to precipitate and the remaining water to separate. The clean essence is then care-

The two-part distillation process begins in a copper still topped with an alembic whose spout guides the distillate through a cooling tank, a technique developed at least a thousand years ago. ***Main photo:*** *Loading the still promptly after harvest.*

fully syringed away and stored in vials, each of which holds one *tolah*, or 11.7 grams (about ⅓ oz). On the market, the price of each *tolah* will vary with the season and with local demand, but it will usually sell for between 2000 and 3000 Saudi riyals—$530 to $800.

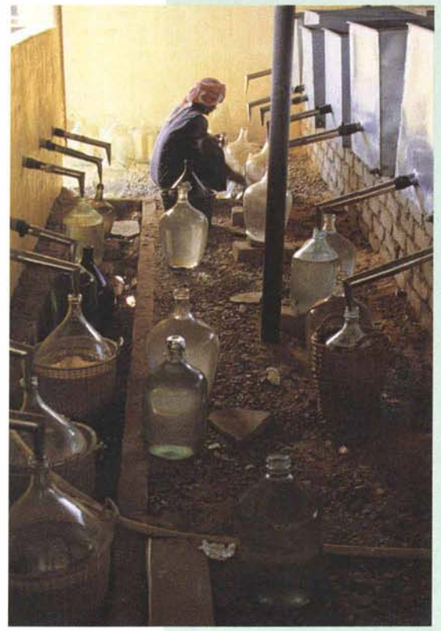
This price is more understandable when one considers that it takes between 10,000 and 15,000 hand-picked roses to manufacture a *tolah* of attar, depending upon climatic conditions. Well-defined night-to-day temperature fluctuations, relative humidity above 50 percent, calm air and clear skies all lead to the formation of early-morning dews which encourage the rose's buildup of ample, high-quality oil. Because these conditions are sufficiently consistent in Taif, the quintessential aroma of Taif rose oil is warm, highly tenacious, immensely rich, deeply rose-floral—truly redolent of damask roses—and embellished with spicy and occasionally honey-like notes. Its qualities easily match—some say exceed—those of rival products from other lands.

By contrast, the highly regarded rose essence from southern France is liberated by an alcohol-based process. It expresses its essence more consistently and completely, but this softer-toned absolute lacks the prominent, spicy topnote offered by traditionally hydrodistilled attar of roses.

For its part, rose water is not merely a by-product. It is in fact the reason that roses were first distilled at all, and today it is a popular, relatively inexpensive product sold for medicinal, culinary and celebratory purposes. It enjoys wide popularity throughout the Middle East, and is a must in every kitchen—though Taifi rose water specifically is rarely found even in Riyadh or Saudi Arabia's Eastern Province. Tradition maintains that *arus* rose water is beneficial for the heart and stomach. This primary condensate is particularly sought-after during Ramadan, when it is used in preparing the fast-breaking meal, and during the 'Id al-Fitr that follows Ramadan, when it is often employed as a flavoring in custards, jellies, sweets and other desserts. Rose water offers a way to refine the socially ubiquitous glass of tea, and it is now often offered as a healthful caffeine-free "white coffee." It also finds a place in the preparation of traditional cosmetics. For example, the black kohl (powdered antimony sulfide) that is used like eyeliner throughout the Arabian Peninsula is often mixed into an applicable paste by adding rose water, which is said to aid impaired vision and combat eye infections.

Rose water, product of the first round of distillation, can flavor tea if fresh roses are not at hand. At left, some of the 60 stills in the al-Qadhi factory. ***Below:*** *Carboys catch the first-round distillate. Only after redistillation, or cohobation, does attar separate from the rose water.*

Hand-held rose-water sprinklers, traditionally made with long straight necks and bulbous bottoms, have a time-honored role in festivities in much of the Muslim world. To mark the end of a wedding feast, rose water is sprinkled on the hands and faces of guests. Aesthetic appreciation and commercial demand have encouraged silversmiths and other artisans to develop exceptionally beautiful sprinklers, examples of which can be found in museums throughout the Arabian Gulf region. In the home, a precious rose-water sprinkler is a symbol of hospitality and, incidentally, a demonstration of social standing and affluence.



Within Taif's rose industry, there is a spirit of competition between the districts of al-Hada and al-Shafa, and local connoisseurs can debate endlessly the relative merits of attar produced from the roses of the two areas. The majority of al-Hada's growers cultivate and process their crop individually; the bulk of the al-Shafa harvest, however, is trucked to the al-Qadhi family's Taif factory.

***Below right:** A Bahraini shopkeeper daubs a gentleman's blend on the top of a customer's ghutra in the traditional fashion.* ***Above:** Several of the Taif-area rose distilleries market their own brands of rose water, shown here with a traditionally shaped hand-held silver sprinkler.*

Until recently, the al-Qadhi establishment was located amid a maze of alleyways in the heart of Taif's old *suq*. For two centuries, the family had operated their perfume factory there, and it was reputed to be the oldest functioning perfumery in Saudi Arabia. Following the 1990 harvest, however, the al-Qadhis packed up their stills and moved to the al-Salamah district, on the periphery of the *suq*. Nearly eight years later, the thick stone walls of the old factory are still suffused with fragrant "essence of Taif."

Since the move, the company has doubled its capacity with 30 new, shiny aluminum vats. Together with their traditional copper ones, still in use, the al-Qadhis now boast 60 *anbiq*s, or distillation units. However, Hasan al-Qadhi, who directs the family business, admits that the new boilers do not perform as well as the traditional copper ones, the oldest of which dates back to 1816.

Nonetheless, under favorable conditions a staggering 35 million al-Shafa roses are distilled there each season, and they surrender 25 kilograms (55 lbs) of attar. Including the production from al-Hada, Taif perfumers thus produce an annual bounty of around 75 kilograms (165 lbs) of pure oil each year—one twenty-fourth as much as Turkey produced in 1997.

Naturally, they also produce millions of cooked flower heads. Most of this mash is sold to cattle farmers, who feed the spent flowers to their cows. In return for this delicacy, the cows produce a mildly rose-flavored milk! The pulp residue is also used as a fertilizer and an organic mulch.

For al-Hada's part, entrepreneurs there have recently pooled their resources and invested in modern stainless-steel hydrodistillation equipment imported from Grasse, in southern France, the world center of perfume production. Over several seasons, this state-of-the-art equipment has delivered a superlative attar of consistent nuance and without off-odors, though at the cost of diminished quantity when compared to the traditional stills. This innovation in al-Hada signals a break with the past, and it seems possible that precious Taifi rose water may become more widely available. An enduring scent that breathes of long tradition, the essence of Taif is likely to remain an evocative and timeless fragrance.

Michael R. Hayward is a dental surgeon who works in Saudi Arabia and has a special interest in perfumes. He lives in Dhahran.

A SPRINKLING OF HISTORY

In the eighth century BC, Homer described how the goddess Aphrodite anointed Hector's corpse with rose oil. In our era, the first-century Greek physician and pharmacologist Dioscorides, in his *De Materia Medica*, mentioned a rose product called *rhodium*, from the Greek word *rhodon*, meaning "rose." But when classical writers spoke of "rose oil" they undoubtedly referred not to the attar we know today, but to fatty oils heavily perfumed with rose by the technique called "enfleurage."

BOB LAPSLEY

As used by the ancient Egyptians, enfleurage involved steeping flower petals in purified animal fat and replacing them as soon as their perfumes had penetrated it. (A similar process, called "maceration," uses hot oil instead of fat.) The perfumed fat was used to make a scented ointment, or unguent. These fragrant balms became known as "pomades," a term which includes aromatic fatty oils employed both for remedial and for aesthetic purposes.

Egyptian wall paintings show cones or balls of pomade atop the heads of Egyptian ladies; the Greek philosopher Theophrastus, writing in the fourth century BC of the manufacture and properties of perfumes, noted that "sesame oil ... receives rose perfume better than other oils"; and rose pomades were popular in ancient Rome. The first-century Roman savant Pliny the Elder described the precautions perfumers took to reduce the odor of the base oil and guard against its turning rancid. Today, small quantities of pomade are still manufactured by virtually the same methods in the region of Grasse, in France, and a rose-scented sesame oil is used in making a certain hair oil in India.

Rose water was distilled by the Arabs at least as early as the ninth century, when al-Kindi wrote his *Kitab Kimya' al-'Itr wa al-Tas'idat (Book of Perfume Chemistry and Distillation)*, but the earliest source that claims to document the origin of attar as a derivative of rose water comes from India. The 17th-century Mughal emperor Jahangir, in his memoirs, credits the discovery of attar of roses to his mother-in-law, Salima Sultan Begum. "This *'itr* is a discovery which was made during my reign by the mother of Nur Jahan Begum," he writes. "When she was making rose water, a scum formed on the surface of the dishes into which the hot rose water was poured from the jugs. She collected this scum little by little; when much rose water was obtained a considerable quantity of the scum was collected. It is of such strength in perfume that if one drop be rubbed on the palm of the hand it scents a whole assembly and it seems as if many red rosebuds had bloomed at once. There is no other scent of equal excellence to it. It restores hearts that have gone and brings back withered souls. In reward for that invention, I presented a string of pearls to the inventor. Salima Sultan Begum—may the light of God be upon her tomb—gave this oil the name *'itr-i-Jahangiri."*

We have no such documentation on the origins of cohobation, the technique that is the key to maximizing the yield of attar. There are no certain reports of its use by the early Muslim alchemists, no mention in literature, and no description of it in any travel account earlier than the second half of the 16th century. We have only one clue, from etymology, that the technique may be of Arab origin. The word *kohob* was used by Paracelsus to mean "repetition," and that word may derive from Arabic *ka'aba*, "to repeat [an action]."

My belief is that cohobation was developed independently in Europe, India and the Arab world, probably—in the case of Europe—in the mid-16th century: A European source dated 1574 names Geronimo Rossi of Ravenna as the first to accomplish cohobation, and *oleum rosarum distillatum*—distilled oil of roses—appears in German apothecaries' price lists of the 1580's.

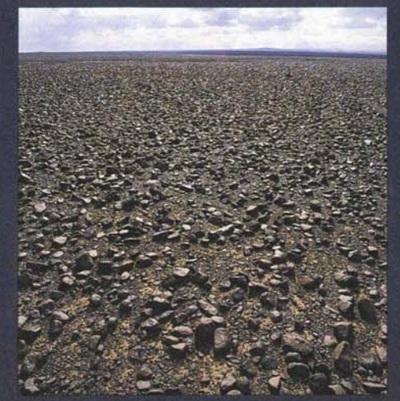
There is also a theory that places the invention in Bulgaria, an important rose-growing country for the past 350 or 400 years. Its adherents point out that multiple distillation was already a well-understood technology in Bulgaria by the time the Ottomans brought the oil-bearing rose there in the first half of the 17th century. To the north of what is now known as the Rose Valley, in the villages around the towns of Gabrovo, Sevlievo and Troyan, plum brandy had been produced for years, its strength and quality increased by repeated distillation. The Ottomans discouraged the production of alcohol, but the distilleries, and the technique of cohobation, were easily adapted to the production of attar of roses.

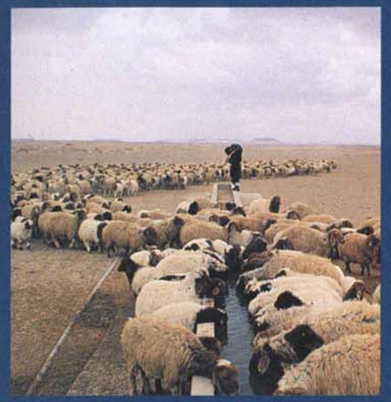
In my opinion, the world's most beautiful attars today come from Bulgaria, Saudi Arabia and Russia, each with a subtle yet distinctive nuance: of spice, honey and softer-hued tonalities respectively. To the many successive generations of inventors who made the production of such beauty possible, we owe our thanks.

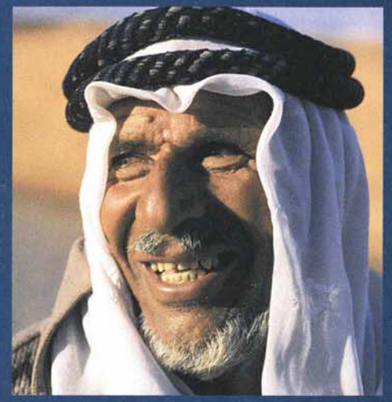
Understanding the Badia

Written and Photographed by Tor Eigeland

Main photo: *Though the Badia is barren in dry times, winter rains average 200 millimeters (7.9") each year, enough to sustain a variety of desert life and centuries of human habitation.* ***Insets from top:*** *In the northwest, the carpet of volcanic basalt can hinder even nimble goats. A caterpillar forages on sprigs of grass. A petroglyph near water at Ghadeer al-Malah indicates that the site has been used since ancient times.*







***Below:** Bedouin herders guide sheep along a hillside. Today, only one-fourth of the region's herders migrate to find grazing, but the average herding family owns roughly 400 sheep. The Badia's total sheep population of 107,000 to 250,000—estimates vary by source and season—and its irregular rainfall result in grazing pressures that vary locally from none to extreme. **Left:** At Gham'r, near the Saudi border, water is pumped by solar power. **Right:** Abu Subaih heads one of the several families whose insights have helped researchers understand the Bedouin economy, which has survived thanks to the advent of trucks, telephones and subsidized feeds. International competition, primarily from Australia, puts new pressures on a marginal way of life.*

The Badia is where we came from," Princess Sharifa Zein bint Nasser said passionately. "It is the beginning of everything here."

"Here" is Jordan, and the Badia is the Jordanian desert, a region larger than Ireland or West Virginia that takes up four-fifths of Jordan's total area. As I zoomed along the desert highway that runs from Amman to the Iraqi border, I recalled that I had asked Sharifa Zein that morning why the region had a special name, rather than being called simply "the desert." Her reply was emphatic.

"*Badia* means the place the Bedouins come from," she said. "To us, it means the beginning. Our livestock comes from the Badia, and parts of the Badia are full of agriculture. We don't think of it as desert. You should see it when it has rained, and the sun comes out! There's life everywhere.

"A long-term goal of our project," she explained, "is eventually to reverse the flow of people crowding into increasingly large cities, to have people go back to the Badia." Like many Jordanian city-dwellers, she added, "I feel lost in the city. My heart is *there*."

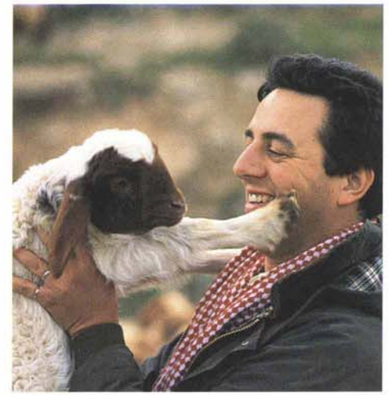
My skepticism at this statement from an elegant, city-dressed woman must have showed. "In spite of my blond hair and blue eyes," she said, chuckling, "the Badia is where I belong. That is where I feel at home. That is where I spent so much time with my father, when I was a child."

I shared some of the princess's feelings. The desert, to me, has always meant extremes—of heat, cold, beauty, peace, pleasure, thirst, adventure, magic and sometimes danger. As we streaked down the blacktop, I felt a thrill of anticipation at the prospect of spending eight days in the desert, based at the field headquarters of the Badia Research and Development Program in the village of Safawi, roughly halfway between Amman and Iraq.

The extremes of the desert were already making themselves felt. Gusts of wind shook our little truck and the temperature was close to freezing, though the calendar said that spring had arrived. Dotted threateningly around the horizon were some of the blackest clouds I had ever seen, with dark grey sheets of rain hanging below them, drenching parts of the desert.

My companion, Ahmad al-Rawajfeh of the Badia Program, pointed out a small rounded mountain on our right: An extinct volcano, he said, one of many in the region. Its last eruption lay between 12 and 26 million years in the past, but the black basalt rocks and boulders it had spewed out lay all around us, so densely strewn that even goats have difficulty crossing this terrain. Each of the rocks, I learned, lies on a patch of blackish, fertile soil that is the remains of its own weathering, and which the rocks themselves protect from dispersal by the strong wind.

Small villages slid past us: simple, square concrete houses; outside them were tents, and flocks of sheep and goats. Most of the inhabitants were settled Bedouins, said al-Rawajfeh, but many of them prefer to sleep in the tents and use the houses—dry, secure and rodent-proof—for storage. They earn their livings farming and keeping livestock or working for the government or the military, and they send their children to village schools. They buy wheat and barley for their flocks, but many of them return to the desert each spring to let their animals forage. The manner of this return often involves phone calls to friends around the country to find out where the rains have been good, then loading the flocks into trucks and setting off, accompanied by a tank truck of water, for the newly greened areas.



Livestock specialist and research coordinator Darius Campbell of the Badia Program examines a healthy lamb reluctant to be vaccinated.

As we drove through the rain, we saw occasionally the tents of truly nomadic Bedouins, a small but significant group of pastoralists who have little or no contact with settled life. Altogether, a quarter of the families who live in the Badia still travel to find pasture for at least part of the year. The isolation of these tents—along with the cold and the rain—made me wonder how the Badia had attracted different peoples and civilizations throughout history, and how they had managed to survive, even flourish, in such an inhospitable region.

The Natufians, Mesolithic hunter-gatherers, lived here around 9000 BC, harvested wild grain and had enough leisure to create art of bone and stone. The Nabataean Arabs made parts of this desert bloom with their ingenious water-catchment systems. Greeks and Romans came and went, as did early Islamic peoples. Inscriptions and the ruins of more than a hundred palaces, multiple dams, canals, cisterns and reservoirs and the 5000-year-old Jawa fort all testify to splendid cultures that prospered here.

Shafts of sunshine—giant rays of it—suddenly pierced the dark clouds ahead of us, striking black basalt rocks that now glittered like diamonds. The desert was demonstrating how beautiful it could be while it thirstily soaked up the water. The winter's rains had largely skipped the Badia this year, measuring well under the annual average of 200 millimeters (7.9"), but with a few more showers, I thought, the Badia could soon be carpeted with green.

We wheeled into the Safawi Field Center, a colorful cluster of renovated buildings. Originally part of Pump Station H5 on a Kirkuk-to-Haifa oil pipeline that operated in the 1930's and 40's, these buildings are now part of a budding academy of desert ecology. There I met Mohammed Shahbaz of Jordan's Higher Council for Science and Technology, director of the Badia Research and Development Program. The Higher Council and two British organizations—the University of Durham's Center for Overseas Research and Development and the Royal Geographical Society, the latter now merged with the Institute of British Geographers—have run the project since the cooperation agreements were signed in 1992.

After dinner, as tea and coffee were served in a continuous flow of hospitality, Shahbaz discussed the project. "The first phase is a survey to establish baseline values, to obtain accurate information about the Badia's resources, human and natural. Since the whole project is centered on benefits for the individual resulting from sustainable development of the Badia, demographic, health and human-mobility studies are crucial." At the moment, he said, base teams were also studying the region's water, livestock, flora and fauna, geology, mineralogy, energy flows, ecology and more. "In the end, the information we gather will be presented to decision-makers on national and local levels so it can be used to improve the quality of life," he explained. The program's second phase, then, would add development projects to continuing research.

Much can be learned from the Bedouins themselves, Shahbaz added. "The Bedouins have lived here for centuries; they know how to treat their environment," he said, "how to exploit it without destroying it."

With those words, Shahbaz opened the door on an ongoing, vigorous debate about development, local knowledge and the sustainable use of desert environments—a debate with more than two sides, and badly in need of agreed-upon facts, the kind that the Badia Program is intended to establish.

On the one hand, the Jordanian government would like to enhance the available services and create more permanent settlements for a growing Bedouin population—thus easing population pressure on the cities—and the Badia Program includes efforts to identify suitable sites for future villages and towns. Sharifa Zein was quoted in *New Scientist* as saying, "This is virgin land. We have the opportunity to achieve something great here: environmentally acceptable development. I'd like to see more livestock, more farming, more industry and a better quality of life out there."

Ecologists, on the other hand, argue that the Badia is not virgin land, but is used by the Bedouins, whose flocks have grown to exceed 400 animals per household, thanks in part to past government feed subsidies. With or without subsidized feed, they wonder, can the Badia support this many sheep and goats? Are the region's seasonal grasslands being permanently damaged by excessive grazing?

Research coordinator Darius Campbell told me that there are between 107,000 and 250,000 sheep and goats in the Badia Program's study area of 11,000 square kilometers (4250 sq mi), "depending on whose guesstimate you believe. Carrying capacity is a meaningless number since grass is transient, both in time and space. Grazing pressure can vary from zero—which is rare—to immense. A verdant plain can be grazed to nothing in two weeks flat by a load of sheep, some of which are trucked in from cities like Amman!"

Dr. Roderic Dutton, the British director of the project, points out that the fact that vegetation grows higher in study areas of the Badia where grazing is prohibited does not mean that the land in general is overgrazed. Rather, the question is whether, after grazing, it recovers or becomes exhausted. In fact, many scientists now think that desert areas like the Badia are resilient and dynamic, rather than ecologically fragile, and bounce from "grazed-to-nothing" back to green as soon as there is rain. The Bedouins certainly believe that, saying that rainfall is the limiting factor that determines how many sheep and goats the land can feed—a belief that at least one scientist has claimed is merely the Bedouins' way of avoiding responsibility for the damage their flocks do.

I asked Darius Campbell, a livestock specialist with the program who works closely with the Bedouins, what he had learned from them so far.

"We have learned their 'alternative' ways of managing animals," he replied, "but I'm afraid it has not been very enlightening, because they are using a system that is new to them—one that's based on bought grains and trucks. To me, it represents mismanagement rather than well-adapted traditional management. Some of their traditional cures using herbs have been interesting, but the cures that involve branding the diseased parts of their animals with hot irons have been lessons in *un*successful traditional methods!

"What we *have* had," he continued, "is the incredible generosity and open-home hospitality of the Bedouins. We have received from some of them great warmth and love, which has been a wonderful side of our work."

That work is a lot more difficult and strenuous than I ever thought science could be. I went out with Campbell and veterinarian Karen Jones of the program's livestock team on a windy day, with temperatures near zero. Today's job involved trading veterinary care for scientific data: They planned to vaccinate no fewer than 300 sheep, take blood samples from them, and tag the lead animals so they could be tracked by satellite.

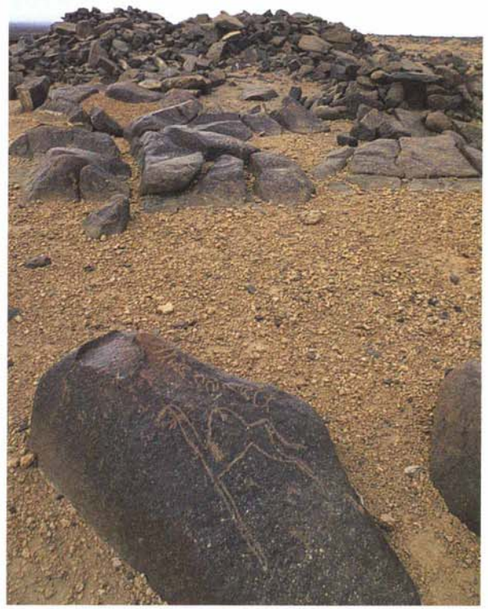
The idea behind this, they explained as we bounced along in their speedy old Land-Rover, was to demonstrate that common, non-fatal animal diseases reduce milk and meat production, and that vaccination against those diseases could therefore mean more production without increasing the size of the flock and the pressure that would put on the land.

"Till now," said Karen Jones, "the Badia people have not been too fussed about non-fatal diseases. They were more worried about diseases that kill the animal outright. The best way to persuade them that vaccination is worthwhile is to let them actually see the results for themselves."

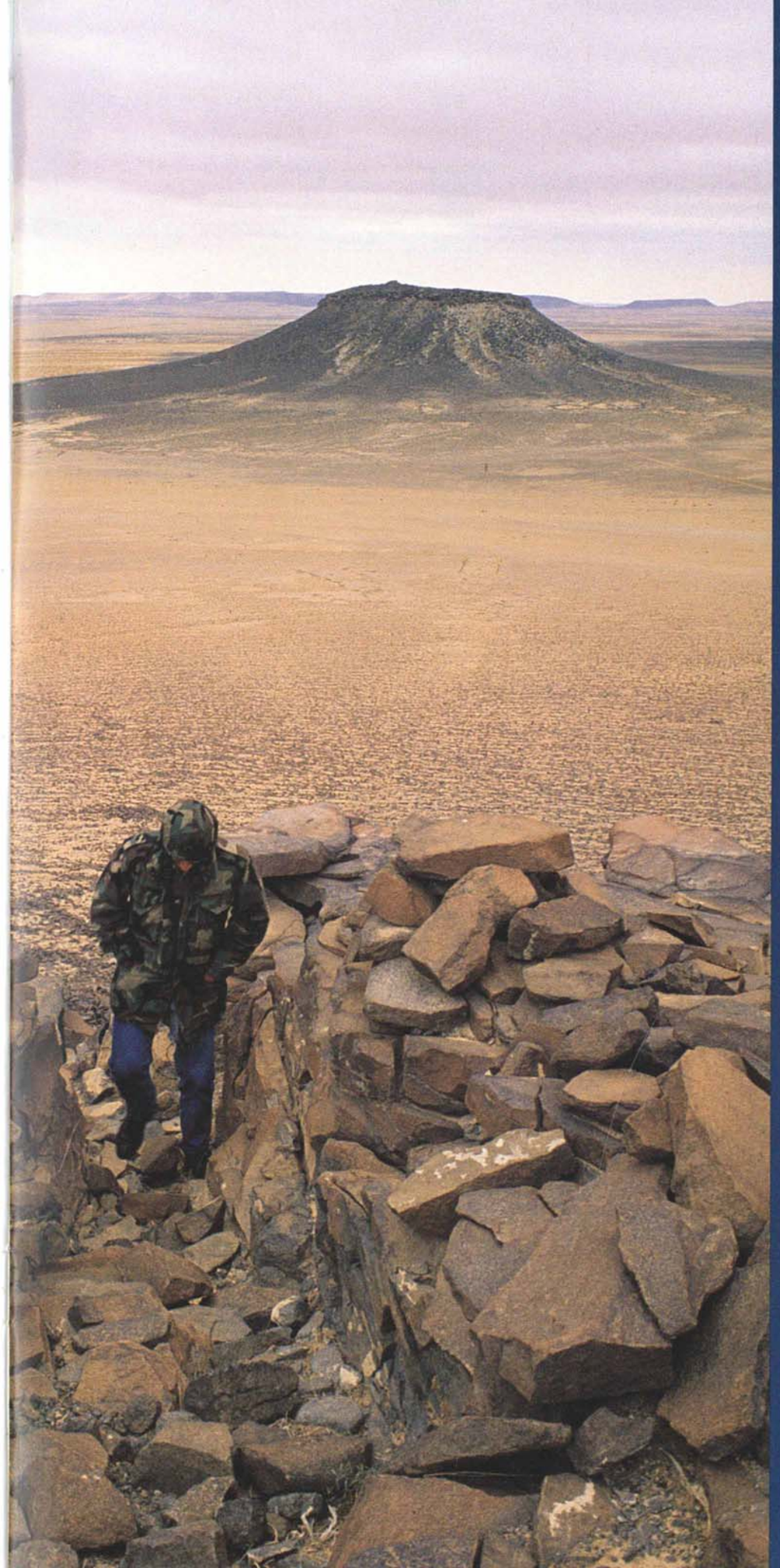
At the appointed time and place, the Badia Program and the Bedouin family met. Campbell and Jones set up a portable corral, the sheep were herded in, and the work began. The teamwork was impressive, with Bedouins and scientists uniting against dumb ovine panic as though they had been doing it for years. Every few seconds a sheep shot out of the corral and up the hillside, phlebotomized, vaccinated and vastly relieved.

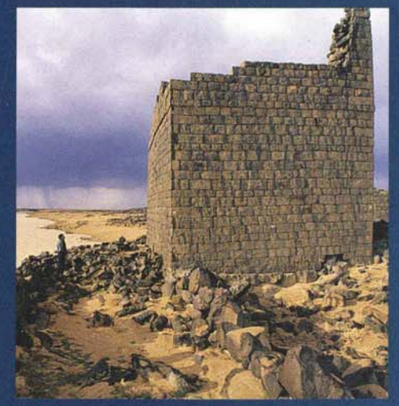
Every aspect of livestock breeding is under study by the Badia Program. Roger Oakley is here as an economist. "Things are sort of stacked against the Badia people," he said. "You cannot produce sheep as cheaply here as in Australia. Even in Syria and Iraq the grazing is better. So far, the Australians have produced and exported merino sheep, which have a different flavor and therefore didn't threaten the market for sheep from the Badia. Now they're starting to raise the *awassi* breed, the same as here. Once the Aussies start large-scale production, the Jordanian producers are going to have bigger problems.

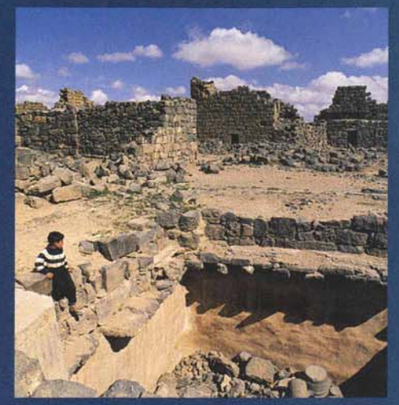
"Realistically, from a hard economic point of view," he added, "it is not very sustainable out here, like it or not."

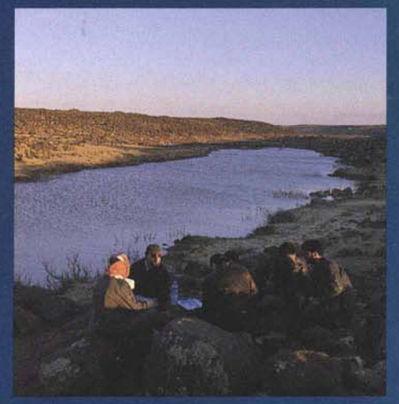


At Wadi Salma near the Syrian border, petroglyphs hint that the site was once a caravan camping ground. The earliest evidence of human settlement in the Badia dates back more than 10,000 years to a people called the Natufians.

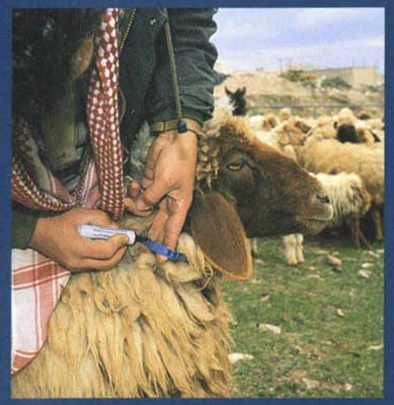


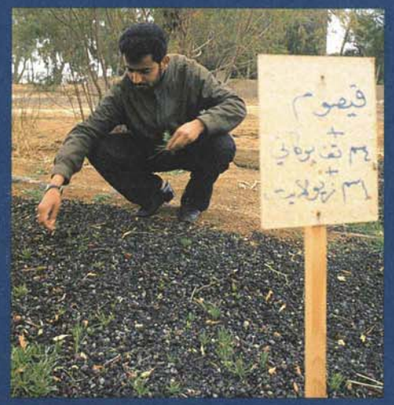






Among the older ruins that dot the Badia is the second-millennium BC hilltop fortification at M'rab al-Qattafi, last used when Babylon was the region's great power. ***Insets from top:*** *Set alongside a long-dammed pool, this building may be a seventh- or eighth-century Umayyad hunting lodge. Roman-era ruins are common, too, and most are not much studied, including these at Dair al-Kahf. Members of the Badia research team gather at a Nabataean catchment pond—still used—that predates Roman times.*





Below: *Solar panels at Gham'r power electric water pumps that fill drinking troughs for sheep.* ***Left:*** *Darius Campbell tags a bellwether with an electronic marker that will allow researchers to track the herd it leads using the Global Positioning System. Under way since 1992, this "academy of the desert" hopes that its multi-disciplinary studies will be an invaluable asset in formulating future development policy.* ***Right:*** *At the Safawi Field Center, Ra'ed Jazi al-Tabini grows lentils, wheat and traditional medicinal herbs in volcanic tuff, which abounds in the Badia. Unique in its ability to absorb water quickly but release it slowly, the tuff allows the plants to thrive; a control group planted in unmodified local soil did not sprout.*

Mohammed Shahbaz, the program's Jordanian director, hopes that modern technology can help make life in the Badia sustainable despite the challenges of modern times. He spoke of using wind power, developing mobile solar-powered coolers, disinfecting water with ultraviolet light and designing energy-efficient, self-sufficient housing.

He also spoke of learning from older inhabitants of the Badia than the Bedouins. Shahbaz would like to emulate the "don't waste a drop" philosophy underlying the ingenious Nabataean waterworks, for example, to reduce the need to pump down the Badia's ancient aquifers to quench the thirst of Jordan's cities or irrigate its farms. The Nabataean Arabs intensively conserved water, he said. Catchment basins were hewn out of the desert rock, and natural depressions were dammed. Canals, some several kilometers long, were dug to lead impounded water to a principal basin. The Nabataeans planted trees nearby to shade these reservoirs and reduce evaporation, and they took great care to keep the water clean. They terraced their arable land with stone walls to reduce water demand. (See *Aramco World*, March/April 1995.)

Today, some of these 2000-year-old constructions still function, and are used by passing Bedouins; others could be restored to working order fairly easily. I visited some basins that contained water even after a nearly rainless winter—more than could be said for some modern-day water systems.

The little lake at Burqu' is a an example. It contains up to a million cubic meters of water (more than 800 acre-feet) in a region where annual evaporation exceeds three meters, and there is water here even in the driest years. The Nabataeans built the waterworks, the Romans built a fort, and the place was used in Byzantine and early Islamic times. The remains of what is said to be an Umayyad hunting lodge stand at the water's edge—and so do Bedouins' tank trucks, sucking up water for sheep and goats. The only other visitors are migrating birds by the thousands, in their season.

The Badia Program's two aspects, development studies and scientific research, feed information back and forth and in effect shape each other in a synergy that has helped make the program by far the most ambitious and comprehensive that the Royal Geographical Society and the Institute of British Geographers have ever undertaken—a quantum leap, said an RGS-IBG official, in terms of complexity and commitment. The complementary use of both high technology and Bedouin technology is another hallmark—and complication—of the program.

The British and Jordanian scientists in the Badia feed the information they gather into the powerful geographic information system of the Royal Jordanian Geographic Center, where it can be overlaid on topographical information collected by remote-sensing satellites and other means. Bellwethers tagged with Global Positioning System receivers barely larger than a pack of cigarettes reveal, on command, the location of the herds they lead. NASA supplies the program with "historical" images, dating back to 1970, that reveal changes in soil and vegetation over time.

No less important, however, are studies of such things as desert almond trees, multiplied by tissue cloning, then grafted by traditional techniques to adapt them to the conditions in the Badia. "We take the native almond plants," says Mohammed Shahbaz, "we reproduce them and graft on sweet almonds. The desert almond can tolerate a temperature of 50 degrees centigrade [122°F] and its water requirement is only 50 millimeters [2"] per year. When you modify the plant, even if it now requires 100 millimeters of water, it will be perfectly feasible to grow these in the Badia."

Ra'ed Jazi al-Tabini, a Jordanian agricultural scientist, showed me his study of traditional medicinal herbs grown in volcanic zeolite tuff. Cheerfully greening in his little plot, despite a long dry season, were *Artemisia herba alta, Achillea fragrantissima* and *Thymus bovi*, specifics for stomach disease, diarrhea and respiratory diseases respectively. In a neighboring plot of unaltered local soil, the same species planted as controls refused to appear this year.

"Natural zeolites are common in volcanic rock," explained al-Tabini, "and because of their cage-like molecular structure, the rock absorbs water quickly and releases it slowly." Since volcanic tuff is cheap and locally available, al-Tabini's experiment has important implications for growing things in the desert.

It was 25 years ago that Jordan's crown prince, Hassan bin Talal, conceived of a long-term, multidimensional study "to understand the geography of the fragile Badia system and to make recommendations for change and development that will be sustainable and of real benefit to the Bedouin people of the Badia." The RGS-IBG sums up the program's goal simply as "helping the development process based on solid geographical information." Both the prince's statement and that of the RGS-IBG recognize that geography is in fact, as British political geographer Sir Halford Mackinder called it, "the bridge between nature and culture." We can understand each only in the context of the other. ⊕

There is much to learn from the land's former inhabitants, says Mohammed Shahbaz, Jordanian director of the Badia Program. He holds a particular respect for the 2000-year-old waterworks of the Nabateans. The Romans, who conquered the Nabataeans, built this arch near Wadi Useikhim.

Photographer and writer Tor Eigeland also contributed Aramco World*'s 1992 article on an* RGS-IBG *ecological study in Brunei. He lives in southwestern France.*

"The Most Splendid Manuscript"

Some opportunities occur not once in a lifetime, nor once in a century, but just once, period. Unless you belong to England's royal family, it is only now that you can see more than two pages at a time of the Padshahnamah, *one of the most famous illuminated manuscripts from Mughal India. For reasons of conservation, this 17th-century book has been, for the first and only time, unbound. Its 45 glorious illustrations were shown first in Delhi, in honor of the 50th anniversary of India's independence, and later in London; through the end of 1998 they are on view in the United States. After the* Padshahnamah *is rebound, it will be returned to its glass case in the Royal Library at Windsor Castle, where visitors can view only the pages to which it is opened.* Written by Caroline Stone

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The Mughals were the second wave of conquerors who brought Islam to India. Descendants of the Mongols—their name is a Persian form of "Mongol"—they came from what is now Afghanistan shortly after 1500. Their first emperor was Babur, who claimed descent on his mother's side from Genghis Khan and on his father's side from Timur (Tamerlane)—an impressive genealogy! Throughout its roughly two centuries of rule, the Mughal court showed a passion for the arts and sciences: for painting, architecture, natural history and philosophy. Under its patronage, both men and women wrote autobiographies, poetry and letters. Babur and his descendants were, like their Persian and Mongol relatives to the west and north, deeply concerned that the histories of their reigns should be set down in as detailed and elegant a way as possible. (See *Aramco World*, May/June 1997.)

— **Detail below:** *Shah Jahan frequently received European envoys bearing gifts and seeking trading privileges. The emperor sometimes found the gifts unworthy of kings who claimed to be powerful monarchs. European paintings, however, were welcome gifts, and several were placed in the royal* jharoka (**detail above**). *Such paintings influenced Mughal artists and broadened their repertoire of symbols.* **Opposite:** *Shah Jahan distributed to the poor several times his own weight in gold, silver and other valuables twice each year.*
Previous spread: *The* Padshahnamah *traces Shah Jahan's lineage back to the conqueror Timur (Tamerlane). In this detail, Shah Jahan raises his hand to accept the crown that Timur, on the facing page, holds out.*

Though the extent of their empire was rarely stable, it was always considerable, and the Mughals grew to be perhaps the richest ruling house of their era. Their main competitor for that title would have been China; Spain, in spite of the new-found, fabled treasures of the New World, was in fact poor in comparison. The Mughals could afford to indulge their wishes on an unrivaled scale. And so, the books they commissioned were as magnificent as their buildings, and among those books, the *Padshahnamah* is a crown jewel.

The *Padshahnamah*, which literally means "Chronicle of the King of the World," was commissioned by the emperor Shah Jahan as a record of his reign, just as the *Akbarnamah* had set down the achievements of his grandfather, Akbar. The scholar chosen for Shah Jahan's task, Abdul Hamid Lahawri, was famous for his flowery style, but whether his age prevented him from completing the work, or whether the folios chronicling the final two of Shah Jahan's three decades of rule were lost or destroyed, we may never know: Today, the Padshahnama covers only the first decade of Shah Jahan's reign.

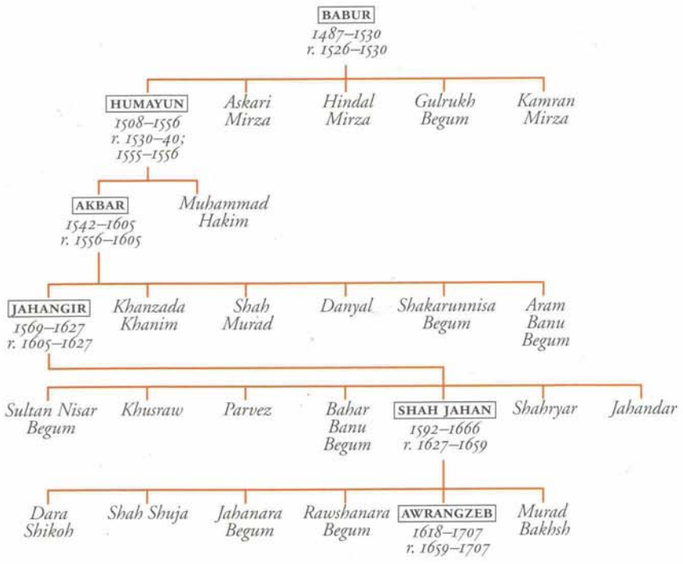
In 1639, when the *Padshahnamah* was commissioned, Shah Jahan was, in addition to his affairs of state, preoccupied with another artistic project: the building of a tomb to commemorate his beloved wife, Mumtaz Mahal, who had died giving birth to their 14th child some years before. The tomb became known as the Taj Mahal. He was also struggling both with far-flung insurrections and domestic friction between his two eldest sons, the free-thinking Dara Shikoh, his favorite, and the austere Awrangzeb, who would forcibly succeed his father in 1658.

It is hardly surprising, then, that in the *Padshahnamah*, Shah Jahan appears glad to dwell upon the happier past. The paintings recount his personal triumphs as a young man; his father, the emperor Jahangir, congratulating him on his victories; processions and celebrations; and especially the imperial marriage of the heir-apparent, Dara Shikoh. (See pages 22 and 23.) In other paintings we see Shah Jahan as a young man rescuing a servant from a lion; we see the young Awrangzeb heroically confronting a maddened elephant, and several times in the *Padshahnamah*, Shah Jahan, naturally enough, seems pleased to think of his story repeating itself in the persons of his sons.

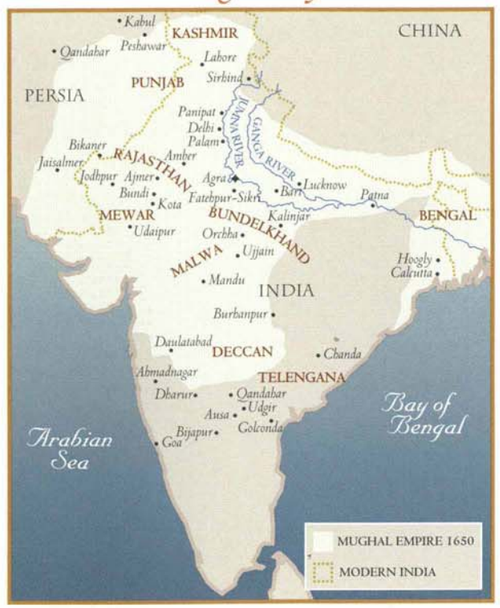
Indeed, with the *Padshahnamah*, Shah Jahan was following a family tradition of historiography. Almost every Mughal ruler caused to be produced an official history of his reign. Shah Jahan's father, Jahangir, kept a diary, known as the *Tuzuk-i-Jahangiri*. He wrote that when a fair copy was ready "I ordered those in charge of the royal library to bind the account of the twelve-year period in a single volume and to make a number of copies for me, both to give to people in my service and to send to other countries to be used by the rulers as a manual of statesmanship. On August 20th, 1618, one of the secretaries brought me a copy written out in full and bound. As it was the very first copy, I gave it to my son Shah Jahan, whom I consider the foremost of my sons in everything."

Shah Jahan followed in his forefathers' footsteps. The *Padshahnamah*, like the earlier family chronicles, was written in Persian. This was the Mughal court language, although Chagatay Turkish, the language in which Babur had written his autobiography, lingered on for private family use. Arabic

The Mughal Line



The Mughal Empire



— **Opposite:** *In October 1636, Mughal forces accepted the surrender of Udgir, thus securing control of the kingdom of Ahmadnagar in the Deccan. However, because the paintings in the* Padshahnamah *were inserted well after the text was written, this one may actually show a different Deccani surrender. Note that the captives are depicted frontally while the Mughals are in profile; in Mughal portraiture, the latter view was the more prestigious.* **Previous spread (detail):** *With extravagant ceremony, servants preceded by musicians and garland-bearers carry trays of gifts to the house of Prince Dara Shikoh's bride. The procession had been delayed a year after the death of the prince's mother, Mumtaz Mahal.* **Next spread (detail):** *The elephant was a symbol of royal power, and court-sponsored elephant fights were a regular event. On this day, an elephant called Sudhakar turned on the retinue of Prince Awrangzeb, who faced it down bravely.*

was regarded as a holy language not to be used for secular matters, but only for the study of the Qur'an, for prayer and for interpretation and disposition of *shari'ah*, or Islamic law.

Abdul Hamid Lahawri's text for the *Padshahnamah* was copied by the famous calligrapher Muhammad Amin al-Mashhadi, who did not complete his task until 1657. As was often done at the time, he left blank spaces on the large folios. These were to be filled in subsequently by the miniaturists, who would know exactly what subject to choose for the space. In their task, the painters would draw on detailed court archives, and possibly also on sketches by official draftsmen, which would tell them precisely who was present at which occasion, and in what position they should be depicted according to their political standing. They would also learn what gifts were offered, what Shah Jahan wore, and numerous other points of significance for their task.

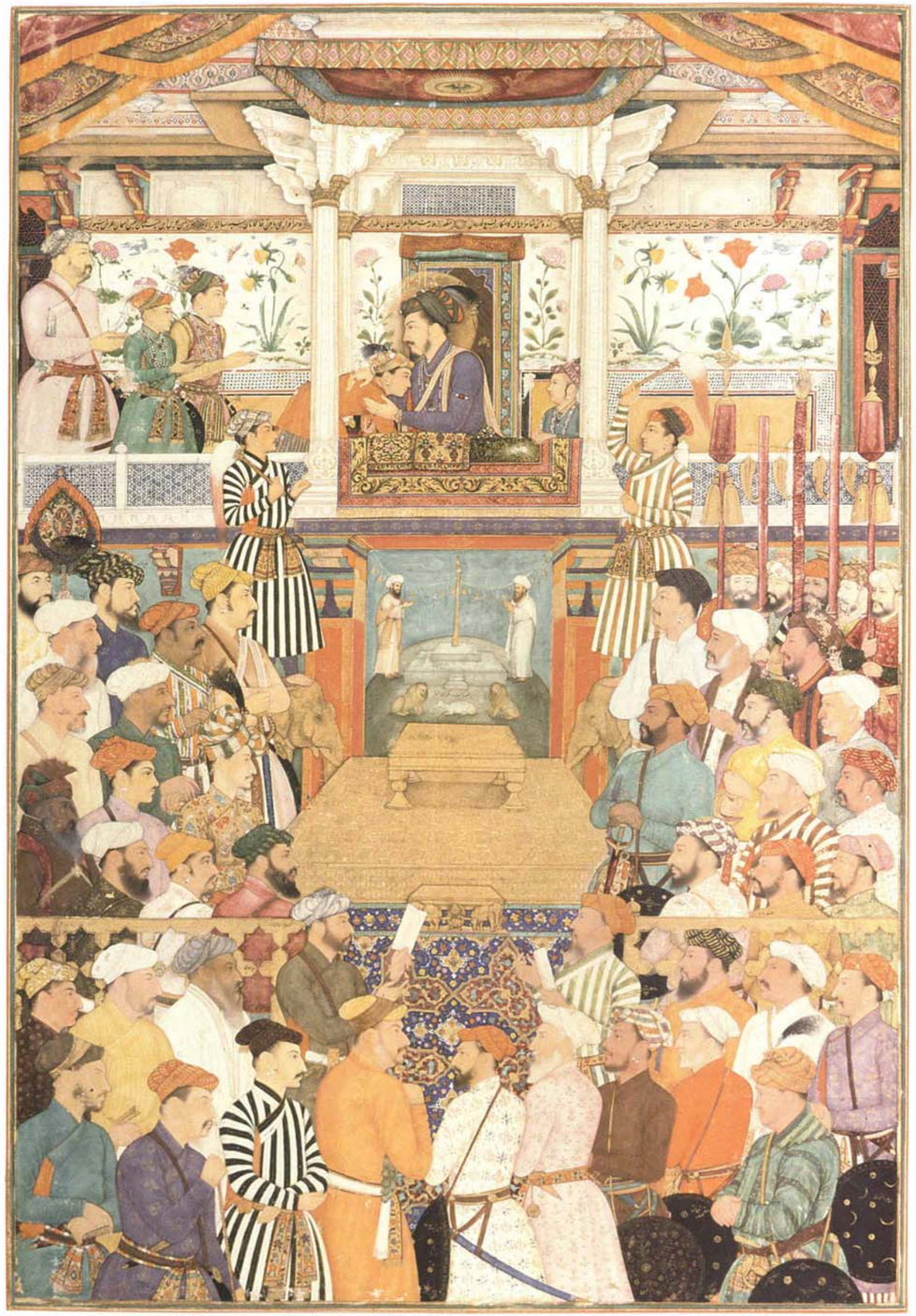
But the *Padshahnamah* is interesting and unusual in that these spaces were not filled in the normal way in the royal workshops. Before unraveling what actually happened, however, let us consider for a moment the general question of painting at the Mughal court.

By the time of Shah Jahan's accession, the wealth of India was attracting increasing numbers of foreign diplomats and traders. The Dutch, Portuguese and English were trying especially hard to set up trading posts and even colonies in the southern and western reaches of the Mughal realm. To do so, they were bidding actively for diplomatic privileges at the court of the "Great Mogul," as they called the emperor.

The Mughals, however, were not particularly interested in trade with the West. By and large, India produced everything considered needful and much more besides. Nonetheless, they were curious about Europe and, more to the point, they wanted to negotiate favorable terms for the transport and protection of pilgrims to and from Makkah, since by the 17th century it was no longer the Arabs but, to a large extent, the Europeans who controlled the waters between Arabia and India. The Mughals, besides wanting to ensure the safety of their own family members on the Hajj, also felt responsible for the many subjects who likewise set off to visit the holy places. This was the European envoys' strongest bargaining point.

Several of the European visitors left accounts of their missions. An early English ambassador, Sir Thomas Roe, lamented the difficulty of finding suitable presents for Jahangir, a man who literally had everything. Among the gifts well received in the Mughal court, however, were paintings, and one of the miniatures in the *Padshahnamah* shows a row of European paintings behind Jahangir's throne. (See page 21.)

These gifts from afar influenced the court painting of the period. The miniatures produced at the court of Shah Jahan show a more thoughtful approach to perspective and to portraiture



than do works of the previous century. Compared to the often stylized earlier miniatures from Persia, Central Asia or Herat, seat of the Timurid empire, the *Padshahnamah* paintings are sophisticated. They are not simple generic illustrations for "the hunt" or "the feast" and so on; rather, they are accurate, almost empirical records, which, like press photographs today, could be retrieved from an archive to check protocol: Who stood where? Who wore what? How did the foreigners dispose their cannons at such-and-such a siege? What were the fortifications of this town like before their destruction? Today, of course, the paintings supply us too with a wealth of reliable detail on many aspects of Mughal life.

Similarly, it is also interesting to have so many portraits of the advisers, generals, shaykhs and even the artists themselves, all of whom played such important roles in the history of northern India. Knowing what they really looked like makes them less remote and more memorable.

A good example of this is Asaf Khan, who appears in numerous miniatures in a position close to the reigning sovereign. In the *Padshahnamah,* he appears accompanying Shah Jahan's young sons into the emperor's presence at the latter's accession ceremony. Asaf Khan, himself the son of a high official, was the father of Mumtaz Mahal, and thus Shah Jahan's father-in-law; he was also Shah Jahan's chief minister and tutor to his sons Dara Shikoh and Awrangzeb. Asaf Khan's sister, Nur Jahan, was Jahangir's favorite wife, and her influence in political matters was paramount in her time. She was also a fine poet and a fair shot, and she cultivated a passion for design in textiles, carpets, fashion and interiors. Thus, though she herself is not portrayed in the *Padshahnamah,* the beautiful settings, costumes and embroidered hangings that appear in many of the paintings doubtless owe a good deal to her influence. Thus it is hardly surprising that Asaf Khan appears in no fewer than 18 paintings in the *Padshahnamah!*

The miniatures of the *Padshahnamah* do not show only European influences, but also possibly Far Eastern ones–a tribute to the far-flung contacts of the Mughal Empire. Roe and other sources tell us that the Portuguese were beginning to import Japanese goods from their trading station at Deshima and that paper, lacquer and sword blades were in great demand. One or two miniatures seem to show the influence of these contacts, both in the coloring and in the stylization of the landscape. The effect is elegant and the contrast with other scenes in the volume greatly adds to the *Padshahnamah*'s overall richness and variety.

In 1657, the copying of the *Padshahnamah,* as far as it goes, was complete. The blanks in the text waited to be filled with paintings. But the following year, Awrangzeb entered Agra and took his father prisoner. In 1659, Awrangzeb had Dara Shikoh executed, sent his head to his father in a covered dish, and assumed the Mughal throne. Memories of this were to haunt Awrangzeb in his later years as he, perhaps the richest man in the world, lived out his last days copying the Qur'an and sewing caps to pay for his funeral with the labor of his own hands.

— **Opposite:** *After Shah Jahan's accession in 1628, his sons were brought to court and the emperor designated Dara Shikoh his heir-apparent. Legitimacy, harmony and peace are implied by the painting's symmetry and by the image of a lamb with two lions in the fresco beneath the* jharoka. **Above (detail):** *In a painting of a ceremony in 1617, an allegory of misrule appears below the* jharoka *of Shah Jahan's father, Jahangir, against whom Shah Jahan rebelled.* **Below (detail):** *In another* jharoka *fresco, the "peaceable kingdom" image is taken directly from a Bible brought to India by Jesuits.*

But who, then, filled in the *Padshahnamah* with paintings, and when was this done? The paintings are by no fewer than 13 identifiable artists (most of whom included self-portraits within at least one painting), including some of the most famous miniaturists of the Mughal court. But as is pointed out by Milo Beach, director of the Smithsonian's Freer and Sackler galleries in Washington, D.C. and coordinator of the *Padshahnamah* exhibition, the manuscript is in fact a collage. Paintings have not only been trimmed from their original sizes to fit the spaces left by the calligrapher, but on several occasions the paintings inserted do not exactly match the text. Clearly the assembly of the book was carried out after personal memory of the events in question had faded.

The paintings that were chosen are thus correct as to general subject, but not always accurate as to date. For example, in one we see Shah Jahan, in the splendor of his middle years, honoring Awrangzeb at the latter's wedding in 1637. At a supposedly earlier date, Shah Jahan is shown in another painting hunting deer, but depicted as a noticeably older man than at his son's wedding. Presumably the hunting scene was simply pulled out of the royal

— **Below (detail):** *In a ceremony illuminated by torchlight and fireworks, Shah Jahan presents his son Awrangzeb with a* sehra, *or bridegroom's veil, "of lustrous pearls among which were strung rubies and emeralds" on Awrangzeb's wedding day. Two decades later, Awrangzeb imprisoned Shah Jahan and forcibly took the throne. Though this painting is the penultimate folio of the* Padshahnamah, *Shah Jahan appears younger here than he does in the hunting scene* **opposite,** *which seems to illustrate a considerably later event. The unknown compiler of the* Padshahnamah *apparently selected the painting from the court archives simply because its subject was appropriate for this portion of the* Padshahnamah's *text.*

archive to fit the subject of that part of the text. In fact, given the apparent age of Shah Jahan in it, the portrait must date from shortly before he was imprisoned by Awrangzeb. Perhaps this painting is a record of one of his last hunting expeditions as a free man.

The way the book was put together does not in any way detract from its splendor. On the contrary, it gives us richer and more varied illustrations than we would have had if a single artist had completed the book as it was originally commissioned. Furthermore, both the Mughals and the Ottomans had the habit of making up lesser albums in this collage fashion, and so, in this regard too, the *Padshahnamah* exhibits traditional characteristics of the arts of the book. But the more difficult question remains: Who ordered the manuscript to be completed?

It was, quite obviously, not Shah Jahan, for he would surely have had the paintings done directly on the pages, in the spaces prepared, by court artists. Awrangzeb? No. He disapproved of the arts in general, even though a good deal was nonetheless produced during his reign. Even more, Awrangzeb hated his elder brother Dara Shikoh, of whom the *Padshahnamah* is lavish in its praise. The most plausible hypothesis places its assembly in the early 18th century, when Awrangzeb's death in 1707 and his "divide and rule" policies had provoked exactly the general decline that he had so much feared, and the court was turning back in nostalgia to a time that was increasingly regarded as the zenith of the Mughal dynasty.

Thus it may have been between Awrangzeb's death and the 1739 destruction of Delhi that someone going through the royal library, or the remains of the often-looted treasury, decided to complete the volume from the existing stock of paintings of major events. Here it is helpful to understand that court painters in fact produced many paintings that were never incorporated into albums, and they did so to maintain a royal archive that was as important then as an archive of photographs would be today.

The deterioration of the Mughal house over the 18th century, and its final dissolution in the early 19th, brought unrest throughout India as principalities vied against each other. The British, desirous of a stability that would secure trade and increasingly capable of themselves filling the vacuum left by the Mughal decline, annexed much of the country by treaty and conquest. They took full control at Delhi in 1803, and exiled the last Mughal ruler by mid-century.

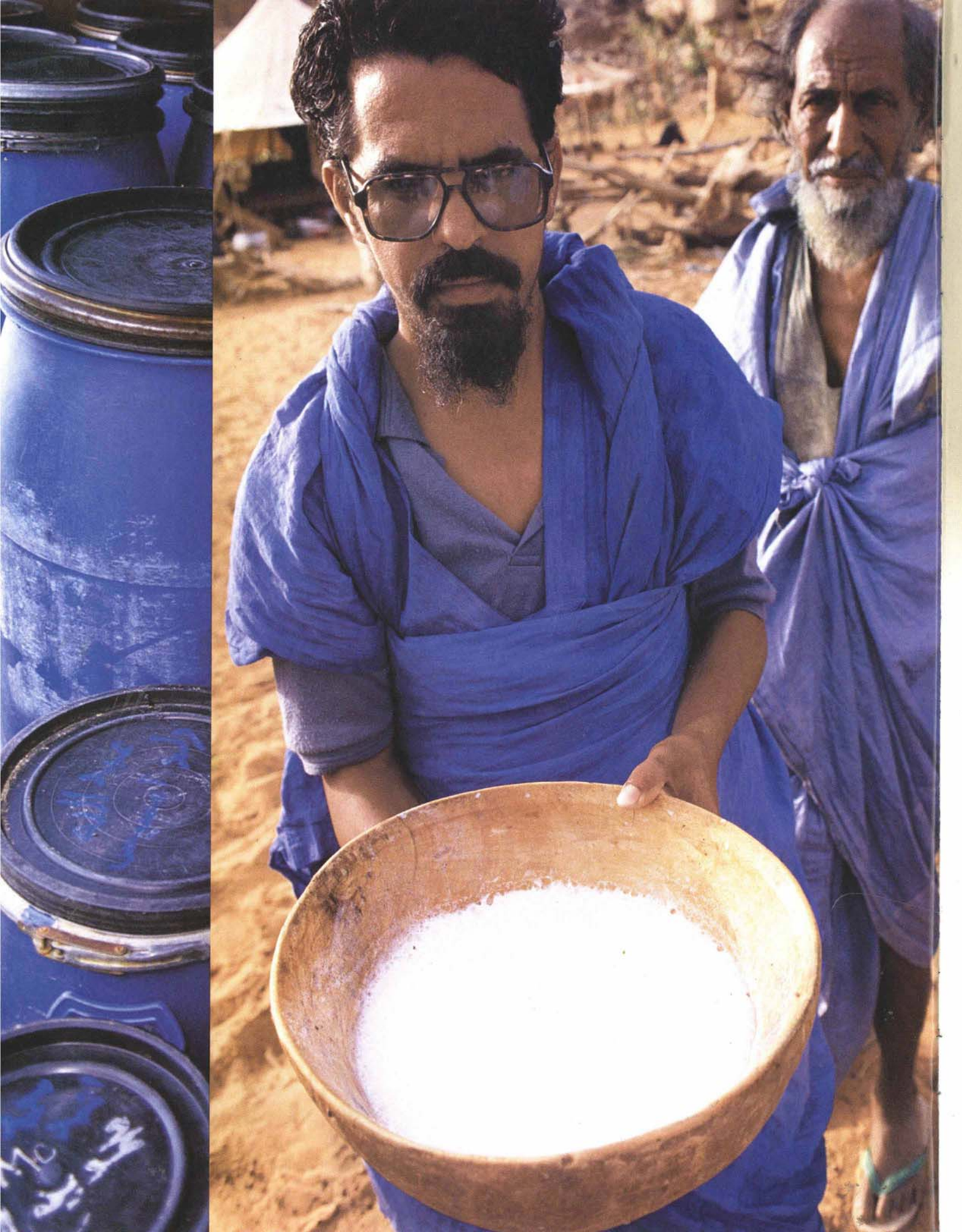
In 1797, the British Governor General of India, Lord Teignmouth, working under a commission from King George III, paid a state visit to the Nawab (ruler) of Lucknow. The following letter, dated June 1799, is preserved in the Royal Library at Windsor Castle:

"When Lord Teignmouth was at Luknow, a Book was produced to him out of the Nabob's Library, as a most splendid of oriental manuscripts and its acceptance was pushed upon him. Lord Teignmouth declined receiving it with an observation that it was fit for a royal Library. The observation however suggested the idea, that as a literary curiosity it might be acceptable to the King of Great Britain, and he mentioned it afterwards to the minister at Luknow, that he would not hesitate to accept it, in the idea of depositing it in the royal Library if his Majesty would think proper to allow it. The Book, with five others suggested by the Minister, as elegant specimens of Persian writing, were sent to Calcutta, after Lord Teignmouth's departure, and forwarded by his Attorneys to Europe. They have been lately received by Lord Teignmouth, and are now in his possession; he will be happy to be honored with his Majesty's orders respecting them."

Among Lord Teignmouth's descriptions of the five manuscripts there is this note: "This is the most splendid Persian manuscript I ever saw. Many of the faces are very well painted and some of them are portraits. The first is the portrait of Timur or Tamerlane, and the second that of Shahjehan. This was the book which was shown to me at Luknow, and I was there informed that the deceased Nabob Asophuddoulah purchased it for 12,000 rupees, or about £1550."

And thus the *Padshahnamah*, commissioned by an Eastern emperor and completed mysteriously after his death, passed into the possession of a Western king. The present opportunity to view it in its fullness is one not to be missed.

Historian and writer Caroline Stone lives in Seville, where she teaches for the University of Wisconsin. Her latest book is Mantónes de Manila (Manila Shawls).



MAURITANIA'S DROMEDARY DAIRY

*"The first three years were dismal, but the last three have been exhilarating," says Nancy Abeiderrahmane of her dairy, which has put fresh camels' milk in Mauritanian grocers' coolers. "Considering the hurdles I have encountered, I must have a very obstinate nature." **Opposite**, herders offer a bowl of fresh camels' milk; the rest of the day's milking will go into the dairy's blue collection drums.*

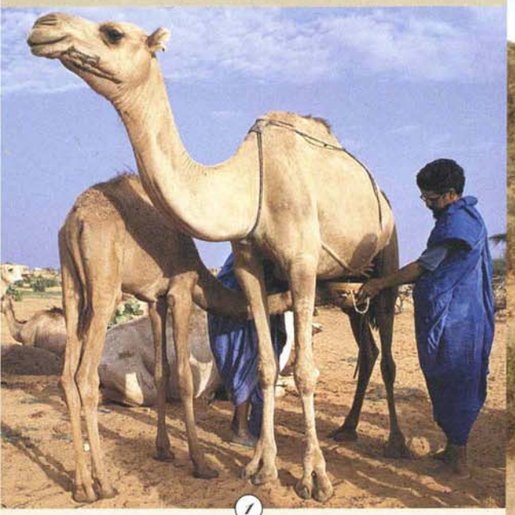
It's six o'clock in the morning and the sun is still pale as dozens of delivery vans converge on a building in the outskirts of Nouakchott, Mauritania's capital. The men busily unloading plastic barrels and carrying them inside seem as regimented as assembly-line workers, but they are in fact nomadic herdsmen. They are the most important link in a network that collects camels' milk gathered at dawn in camps and villages outside Nouakchott and delivers it, pasteurized, packaged and chilled, to city shops that same morning.

The building in question is a dairy, and it is the first in Africa to pasteurize and pack camels' milk. In the Islamic Republic of Mauritania, where the majority of the population are herdsmen rather than farmers, the dairy is an outward sign of the gradual accommodation of the traditional and the commercial worlds.

The camel has long been the Swiss Army knife of life in the desert, providing transport, meat, dung for fuel, urine for medicinal uses, hair that can be woven into tents and wool to make carpets, as well as milk to drink. The dairy and its delivery system have now made camels' milk a valuable source of cash income for nomadic herdsmen, and allow city-dwellers to enjoy a healthy drink that links them with their past. Camels' milk has many advantages over the imported ultra-pasteurized "long-life" milk previously drunk in Mauritania. It is rich in potassium, iron and magnesium, and three-quarters of a liter—about three glasses—provides the full daily requirement of vitamin C. It has a low cholesterol level and is acknowledged to be good for diabetics. Scientists have been surprised by its fatty-acid structure, which includes a protein identical to insulin—a revelation that may have useful consequences.

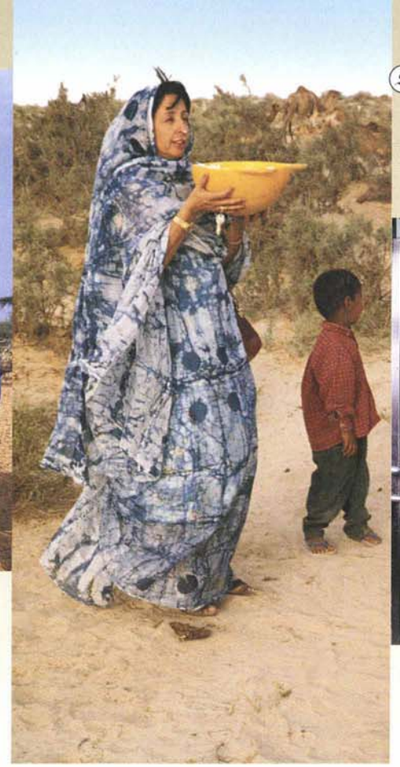
The dairy is the brainchild of Nancy Abeiderrahmane. Born in England, she has lived in Mauritania for over 30 years, and it was her training as an engineer that alerted her, in the late 1980's, to the commercial potential of camels' milk. She makes light of the technical side of the project, which she describes as "a mini-dairy of the sort you'd find anywhere in Europe," preferring to emphasize the health, developmental and financial benefits of her successful enterprise. "All I've done, basically, is to satisfy the town's demand for regular milk deliveries," she says. But in

Written by Sylvia Smith and Richard Duebel • Photographed by Peter Sanders



1

Herders, accustomed to selling surplus camels' milk only irregularly along the roadsides, gradually became accustomed to fulfilling Abeiderrahmane's need for reliable daily supplies. The yearling camel calf above, however, remains unreconciled to the arrangements.



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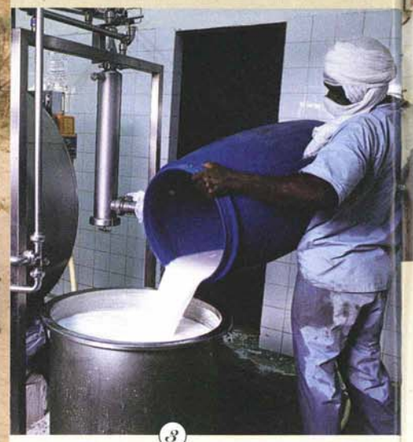
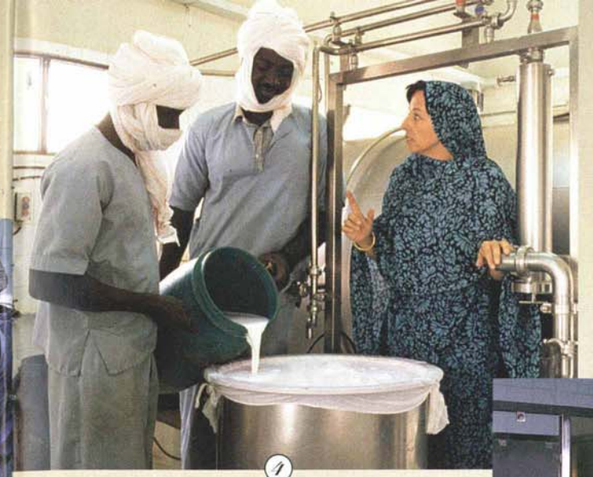
To maintain good relations with her suppliers, Abeiderrahmane pays them regular visits, and samples the goods. The rich foam characteristic of fresh camels' milk leaves its mark.



3

Part of the day's intake of milk is poured into a processing container at Laitière de Mauritanie, Abeiderrahmane's dairy.



4

As the dairy has grown, Abeiderrahmane has branched out into cows' milk and "camelbert," an experimental hard camels'-milk cheese.

Paperboard cartons proved less costly than plastic bottles for packaging "Tiviski" brand camels' milk.

5

6

International recognition came in 1993, when Abeiderrahmane was named one of five winners of that year's Rolex Awards for Enterprise. Local recognition comes daily, in the brisk sale of Tiviski milk at scores of corner groceries.

CAMELS' MILK HAS MANY ADVANTAGES OVER THE IMPORTED ULTRA-PASTEURIZED "LONG-LIFE" MILK. IT IS RICH IN POTASSIUM, IRON AND MAGNESIUM, HIGH IN VITAMIN C, AND LOW IN CHOLESTEROL—AND ITS TASTE HAS ALWAYS BEEN POPULAR.

doing so she has put Mauritania in touch with a substantial source of income both on the domestic market and abroad.

When Abeiderrahmane first came to Mauritania, camels' milk was sold at the roadside from buckets. Given the hot climate, unsold milk spoiled rapidly, and drinking it raw inevitably left consumers vulnerable to disease. Yet camels' milk is an important part of the Mauritanian diet; indeed, it is as much a tradition as a drink. Drought was driving increasing numbers of camel herdsmen to look for work in the cities, and the urban drift in turn fostered reliance on imported products, including more than 50,000 tons a year of sterilized and powdered milk from Europe—a drain on Mauritania's modest foreign-exchange reserves.

Given the Mauritanians' liking for raw milk, Abeiderrahmane needed to be sure that there would be a market for the pasteurized product. Success also depended on whether enough of the city's small corner grocery stores—the mainstay of any retail endeavor—had electricity and could keep the pasteurized milk cool. A feasibility study gave positive results on both counts and, armed with this information, Abeiderrahmane was able to attract local investors and win a loan from a French development fund, the Caisse Centrale de Co-operation Economique. The total was enough to purchase the necessary equipment and begin production, albeit on a shoestring budget.

The early days of the dairy were not without problems. Initially, herdsmen preferred to sell direct to consumers rather than deal with an unknown middle-woman. And unused to the notion of a contract to supply a certain amount of milk every day, they would arrive only when they had excess production—which was mainly in the cold season, when townspeople customarily drink less milk. But gradually, with understanding of the nomadic way of life, Abeiderrahmane won over a group of regular suppliers, enticing them to bring the milk to the dairy themselves in exchange for a regular supply of camel fodder.

Despite small turnover at first, the new pasteurized milk has caught on with Mauritanians and the new cartons, branded Tiviski, are now selling briskly at outlets in three of the country's largest cities. Other members of Abeiderrahmane's family have joined the enterprise. Her son Yahia, who is now production manager, explains that "the sales figures have risen steadily over the last two years. Every shop you go to has cartons of Tiviski, and we've now even got a rival company producing the same sort of thing—the ultimate form of flattery. But we're one step ahead. We've diversified into other camel dairy products, and there are plenty of further possibilities."

Statistics bear out his optimism. Today the dairy, named Laitière de Mauritanie, buys in over 2000 liters every day (530 US gallons) to satisfy demand—10 times the volume it bought daily during 1989. The company has invested in a fleet of small vans which deliver to the countless corner shops that proliferate in Nouakchott. Cartons of milk are regularly air-freighted to the city of Nouadhibou in the north, taken by road to the town of Rosso in the south and even shipped by boat to neighboring Senegal.

As Yahia Abeiderrahmane says, the dairy has moved on to other uses of camels' milk. Fermented milk, a great favorite with Mauritanians, has been added to the repertoire, and a type of light cottage cheese is also popular. Now the company is hoping to tap the European yearning for novelty with a unique product—a tasty, low-fat, hard camels'-milk cheese. A French researcher has provided the necessary scientific know-how to coagulate camels' milk, and now only European Union regulations prevent the "camelbert" cheese from being sold in England and Germany.

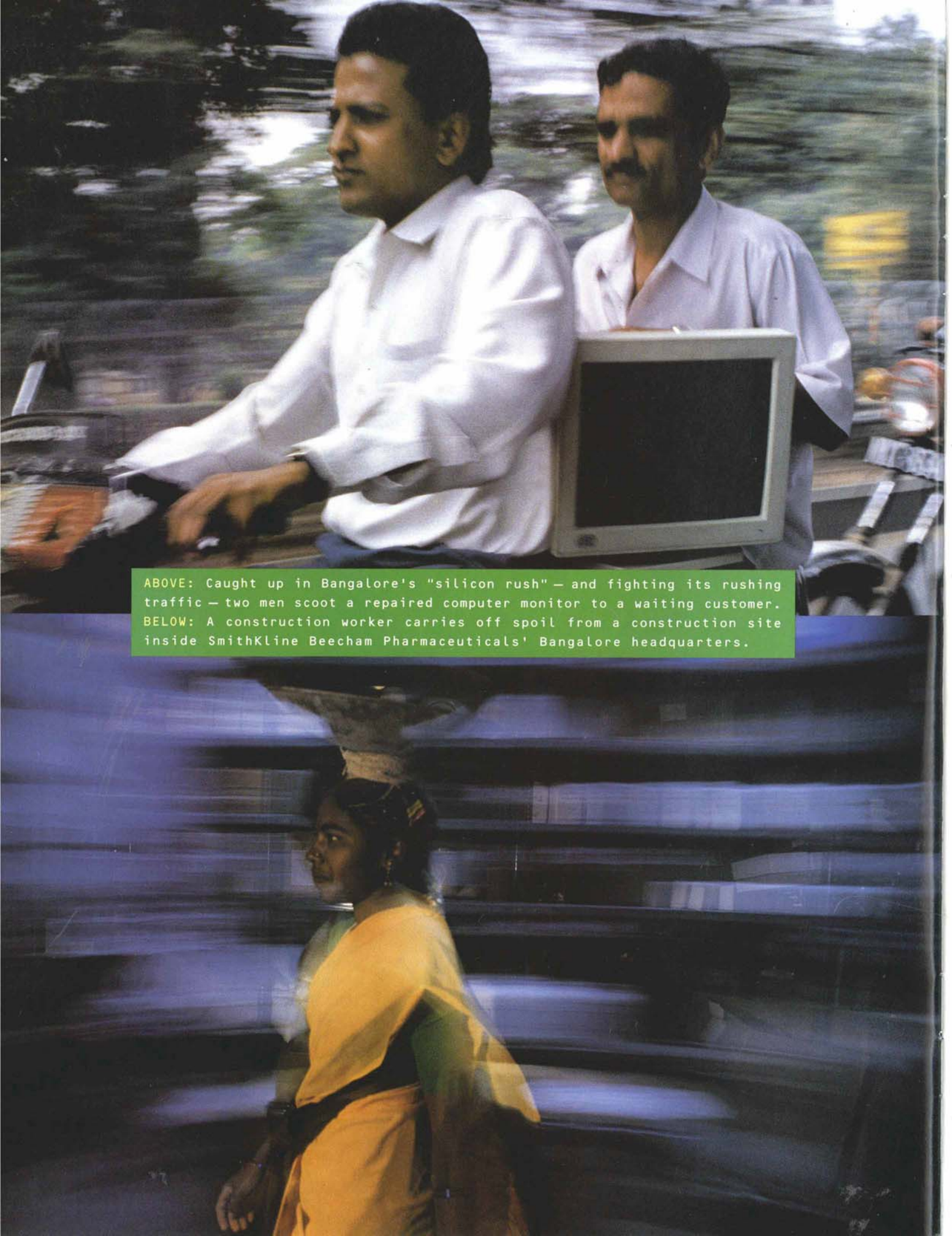
One problem facing Abeiderrahmane is that the European Union does not officially recognize the camel as a milk-producing animal, as it does the cow and the goat. A second difficulty is the lack of a reliable pasteurizing test for the very specific qualities of camels' milk. But Abeiderrahmane is convinced that her product is marketable in Europe. "We took a sample to Harrod's," London's most famous department store, she says, "and the cheese buyer really loved it. Once we get the bureaucratic and technical problems out of the way, I believe the product will sell itself."

With this new role as potential foreign-currency earner for Mauritania, camels' milk is opening up possibilities for a whole swathe of African countries where camels thrive. Nancy Abeiderrahmane's enterprise is developing confidence in Africa that local products are as good—if not better—than anything Europe can provide.

Sylvia Smith is a free-lance broadcast journalist who travels frequently to Africa and the Middle East to pursue her interests in Islamic cultures. Writer and photographer Richard Duebel has traveled widely in Africa. Both Smith and Duebel live in London.

Peter Sanders has photographed worldwide for more than 30 years from his home outside London. He specializes in the Islamic world.

2, 3: RICHARD DUEBEL



ABOVE: Caught up in Bangalore's "silicon rush" — and fighting its rushing traffic — two men scoot a repaired computer monitor to a waiting customer. BELOW: A construction worker carries off spoil from a construction site inside SmithKline Beecham Pharmaceuticals' Bangalore headquarters.

India's silicon city

Written by Yasmin Mahmood > Photographed by David H. Wells

Paul Senna, representative of a US construction company, was scouting for contracts and logged onto the Internet to "talk" with Shahab Ahmed, CEO of Cal-Info, a multimedia production firm in Bangalore, India. Ravi Kolipara, a builder of prefabricated homes in Canada, was looking for an Indian business partner, and also reached Ahmed on the Internet. So did Jairaj Eacharath, an IBM employee in Japan who is considering investing in real estate in India.

The same day, Ahmed e-mailed the names of some "possibles" to Senna and a few others to Kolipara. To Eacharath he sent descriptions of apartments offered by a Bangalore real estate developer whose website, as it happened, Ahmed had designed. Later Ahmed received a note from a software entrepreneur in Australia, and by day's end he had bought and downloaded the software for an Internet-based catalog sales system that met the specifications of a US-based client.

"See what the Net can do!" Ahmed said enthusiastically. "This is how business can be truly international." After 12 years as a project leader with Unisys in the United States, he returned to Bangalore in 1995 to set up his own software firm.

Ahmed is one of tens of thousands of high-tech entrepreneurs, engineers and employees who have flocked to Bangalore, capital of the southern Indian state of Karnataka and, now, the country's cyber-capital as well. Historically, Bangalore has been called "The Garden City" because of its expansive parks and serene lakes, laid out by the 18th-century Mysore ruler Hyder Ali. The British knew it fondly as "Pensioners Paradise," thanks in no small part to its green amenities, and retired there in droves.

But in the last decade, Bangalore has grown into the nerve center of India's burgeoning high-tech sector, which sold $840 million worth of software in the 1994–95 fiscal year and exported 60 percent of that, becoming one of the largest software exporters in the world. It is also, according to *Time* magazine, the fastest-growing city in Asia: Its present population of five million is 10 times what it was in the 1970's.

An Indian software trade association estimates that sales will reach $5 billion by the year 2000. With more than 330 software houses in the city, employing more than 10,000 professionals, Bangalore leads the nation's industry, and has earned a global economic niche large enough to make its name as synonymous with high-tech as Seattle or Silicon Valley. In the press and on the street, Bangalore is called "The Silicon Valley of India," or just "Silicon City."

Bangalore's gardens were a gift of the city's location. It sits high, cool and dry on a plateau, well above the heat of the subcontinent's lowlands. This comfortable climate was well-suited not only to recreation, but also to administration and the pursuit of higher education. It is also, it turns out, no less suited to industries that often require temperature controls and dust-free environments.

According to S. S. Peeran, a real-estate developer and administrative recruiter for the state of Karnataka, "it was the establishment of premier research institutes that set a scientific temper" for Bangalore, and laid the foundations for its leadership in India's electronic economy.

Jawaharlal Nehru, independent India's first prime minister, determined to make Bangalore the intellectual capital of the country, a city-sized think-tank where the ideas and programs that would fuel India's development would be conceived. The Indian Institute of Science, or IIS, still one of the leading research centers in the country, was founded in Bangalore by industrialist J.N. Tata to promote excellence in scientific research. It was soon followed by the Raman Research Institute, (RRI), named after physicist C.V. Raman, who won the Nobel Prize in 1930.

The IIS and RRI paved the way for the Indian Institute of Astrophysics, the Indian Space Research Organization, the National Aeronautical Laboratory, the National Dairy Research Institute and the Indian Institute of Management. The national government invested heavily in scientific and technological infrastructure for more than 40 years, and today the state of Karnataka boasts 30 research and development institutes, 50 engineering colleges, 188 industrial training institutes, 19 medical schools and five computer training centers, many of which are in Bangalore. For industry, the result is easy access to a constant supply of top-grade, high-tech talent.

Government-run heavy industries, called public sector undertakings or PSU's, were established during those same decades. They were the first to benefit from Bangalore's research resources. Now, Hindustan Aeronautics, Hindustan Machine Tools, India Telephone Industry and others are all headquartered in the city. The academic institutions, the research and development institutes and the PSU's share a symbiotic relationship.

Before the 1992 economic reforms that opened India's economy to international investment and partnerships, only Texas Instruments and a few other multinational firms ran high-tech operations in Bangalore. But in a mere five years, the new national emphasis on export-led growth and full multinational participation has converged with the high-tech boom to

ABOVE: More than 330 software development businesses in Bangalore employ about 10,000 people. Average income in the city is 34 percent above the national figure. BELOW: Non-electronic industries such as watch assembly also benefit from the city's skilled workforce.

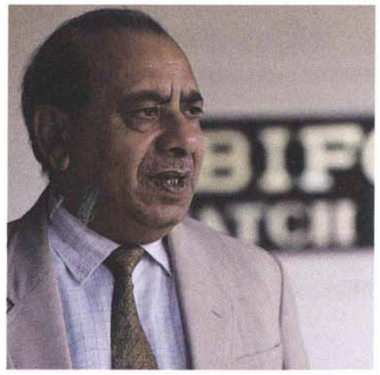
Al-Ameen College, founded by Muslims but open to all, is among the hundreds of educational institutions that power scientific research and manufacturing in Bangalore.

ABOVE: Though the city's population has grown 10-fold in the last two decades, morning can still bring solitude in one of Bangalore's many parks. BELOW: Multinational companies headquartering their Indian operations in Bangalore offer specialized training tailored to their own requirements.

ABOVE: Indian computer professionals earn a fraction of their North American and European counterparts' salaries — a fact with broad implications for the borderless electronic economy. BELOW: "No longer does the phrase 'Garden City' fit," wrote a columnist deploring Bangalore's congestion.

make Bangalore a full-fledged "technopolis." Today, any transnational company with interests in India must consider building its headquarters in Bangalore, and many have: Intel Asia, 3M, Compaq, IBM, Microsoft, Philips, Verifone, Motorola, Digital and SmithKline Beecham Pharmaceuticals are all among Bangalore's growing list of major multinational players.

Those companies' Bangalore operations are not limited to the assembly of electronic components or repetitive data entry: In most cases they include creative software design, sometimes in daily video conference collaboration with colleagues in the United States. The fact that the software designers in Bangalore are well off by Indian standards but earn about a fifth of what their American counterparts do is one of the reasons that, in 1995, *Time* magazine chose Bangalore as one of five world cities that US business leaders need to watch to understand the forces reshaping the global economy and redefining business relations between the United States and the rest of the world.



Ten years ago, Riaz Tareen helped develop the idea of self-contained industrial parks, of which nearly a dozen now encircle Bangalore.

Bangalore's symbiosis of industry, research and training has created a snowball effect, says Riaz Tareen, director of Karnataka State Electronics Development Corporation Limited (KEONICS), especially in electronics and telecommunications. It was KEONICS, which matches entrepreneurs with industries, that masterminded Electronic City on the outskirts of Bangalore, one of the first of now nearly a dozen self-contained industrial parks.

Completed in 1989, the 135-hectare (332-acre) Electronic City houses more than 100 enterprises at the boomtown's economic frontier. These industries, Tareen says, "range from engineering and electronics to software and hardware. We have seen a convergence here from different parts of the world—USA, UK, France, Germany, Japan and Singapore as well as reputed Indian firms."

Hot on Electronic City's heels is Singapore Technology Park, a $480-million megaproject backed by the Tata Group, a leading Indian industrial house, a consortium of Singapore-based companies and the Karnataka Industrial Developmental Board. An international airport for Bangalore is in the works, too: The present one now serves more than 10 times the number of passengers for which it was designed.

It is this overcrowded airport that is often a visitor's first clue to the boomtown's growing pains: Once-abundant supplies of power and water now falter regularly, and industries often set up their own utilities. The air has grown smoggy not because of industry—there are few smokestacks in Bangalore—but because of the numbers of commuters who clog roads built for a city one-tenth the size of Bangalore today. The price of land, once cheap, is rising fast. "It is already hard to recollect that just a few short years ago the city was unique for its charming traffic circles full of greenery and flowers, [but] they have vanished," wrote city activist Ravi Talwar in an article published at www.bangaloreonline.com. "No longer does the phrase 'Garden City' fit our beloved city."

But this isn't deterring anyone, says Tareen, who observes that "nowhere in the country is the infrastructure so well groomed for the high-tech industry. As for the infrastructure problems that have been cropping up, I am confident that they will be resolved." As in any boomtown, he adds, such adaptations take time.

Tareen, who hails from Karnataka, has also worked with his wife, Zareen Tareen, in setting up family-trust scholarships for promising children of low-income families. Zareen has directed a women's self-sufficiency program that assists them in starting small-scale businesses—many of which benefit from the boom's influx of people, all of whom require basic services from sewing to home repair.

"Opportunities abound in Bangalore for investment and professional growth," says N. Ahmed Ali, executive vice-president of SmithKline Beecham, which shifted its operational center from Bombay to Bangalore in 1994. "The youth realizes that there is no discrimination in this industry. Only performance counts."

One notable attempt to broaden opportunity can be found at Al-Ameen College for Science, Arts and Commerce. Founded in 1968 in a crowded corner of the city,

"Poet-manager" Moid Siddiqui of government-owned Hindustan Motor Tools preaches education, awareness, mobility and adaptability as a mantra for managers in the information-technology industry.

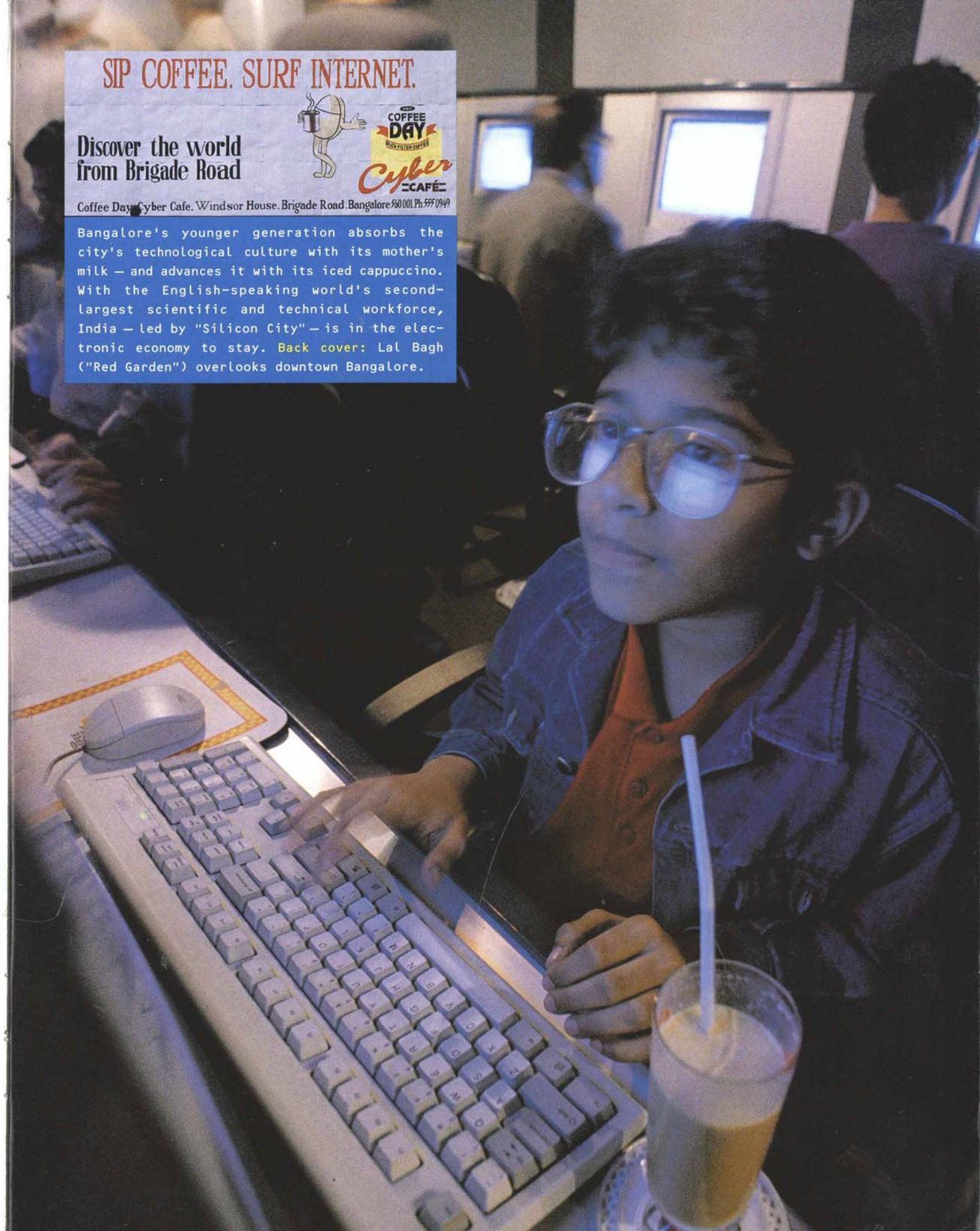
Al-Ameen moved to its own campus in 1976. Since then, it has grown at a pace not unlike that of the city itself. It is now officially a university, offering training in fields from business administration to hotel management, pharmacy and engineering. But more significantly, it is committed to offering higher education to students from all of the city's diverse ethnic and religious communities: Muslims, Hindus, Christians, Sikhs, Parsees, Buddhists and Jains.

Similarly, a community group of software professionals, including Shahab Ahmed of Cal-Info, have plans to start a computer-literacy program for young people called Muslim Infotech Information Trust, whose classes would be open to non-Muslims as well.

"Thus the Islamic emphasis on education as a fundamental requirement, often forgotten, would be realized," says Gul Iqbal, an electronics and software export promoter who hopes to have three of the centers up and running by the end of 1997. With professional help secured and initial investments nearly complete, the plan looks like one among the many promising ideas blossoming along the high-tech frontiers of Silicon City.

Yasmin Mahmood is a correspondent for The Statesman, *published in Delhi and Calcutta. She lives in Cochin.*

David H. Wells is affiliated with the Matrix agency of New York.



Bangalore's younger generation absorbs the city's technological culture with its mother's milk — and advances it with its iced cappuccino. With the English-speaking world's second-largest scientific and technical workforce, India — led by "Silicon City" — is in the electronic economy to stay. Back cover: Lal Bagh ("Red Garden") overlooks downtown Bangalore.

Events & Exhibitions

Along the Southeast Border: *Photographs by Members of the Photographic Salon of Egypt* offers rare views of life among the Busharis and Ababdas, descendants of the ancient Beja tribe of Egypt's Eastern Desert. Sony Gallery, American University in **Cairo**, through December 23.

Pottery in the Making: *World Ceramic Traditions* compares methods by which pottery has been manufactured from the first prehistoric clay vessels to modern industrial mass production. Museum of Mankind, **London**, through December 31.

Striking Tents: *Central Asian Nomad Felts from Kyrgyzstan* concentrates on the boldly colored and patterned floor coverings that insulate the traditional *yurt*. Museum of Mankind, **London**, through December 31.

Splendors of Ancient Egypt displays 200 pieces on loan from the Pelizaeus Museum of Hildesheim, Germany, to give a panoramic view of 4500 years of pharaonic history. **Detroit** Institute of Arts, through January 4.

When Silk Was Gold: *Central Asian and Chinese Textiles from the Cleveland and Metropolitan Museums of Art* displays masterpieces dating from the eighth to the 15th century. **Cleveland** Museum of Art, through January 4.

Homage to Turkey features 100 lusterwear vessels and tile panels by ceramist Gail McCarthy that recover glazing techniques of Seljuk tile masters. Art Gallery of the **Istanbul** Stock Exchange, from January 6 through 26.

Near Eastern Archaeology: *Into the 21st Century* will feature eight leading archeologists speaking about developments during the last decade and the prospects for the coming one. Loyola Marymount University, **Los Angeles**, January 9 through 12, 1998. For information phone (310) 338-1971.

Magan and Dilmun: *Ancient Arabian Gulf States in Mesopotamian Records* is the topic of a slide lecture by archeologist Dr. Moawiyah Ibrahim of Sultan Qaboos University of Muscat. Gallery Theater, **Beverly Hills, California**, January 13. For information phone 818-762-5500.

India: *A Celebration of Independence, 1947-1997* is a collection of 240 photographs that document India's half-century of independence through the eyes of leading Indian and Western photographers. Royal Festival Hall, **London**, through January 18.

The Seven Thrones of Jami: *A Princely Manuscript from Iran* shows, unbound, all 28 of the exquisite illustrations of the 16th-century *Haft Awrang*, or "Seven Thrones," by Jami. Freer Gallery, **Washington, D.C.**, through January.

Searching for Ancient Egypt: *Art, Architecture and Artifacts* surveys the magnificence of the Nile civilizations. **Dallas** Museum of Art, through February 1.

Cairo International Book Fair will host displays by 2400 publishers from 79 countries at the International Fairground in Nasr City, February 5 through 20.

King of the World: *A Mughal Manuscript from the Royal Library, Windsor Castle* exhibits the *Padshahnamah*, or "History of the Emperor," the rarely exhibited illustrated work chronicling a decade of 17th-century emperor Shah Jahan, builder of the Taj Mahal. Metropolitan Museum of Art, **New York**, through February 8.

Teaching About the Arab World and Islam is the theme of teacher workshops co-sponsored by the Middle East Policy Council in Washington, D.C., and conducted by Arab World And Islamic Resources and School Services (AWAIR) of Berkeley, California. Sites and dates include: **Palmer, Arkansas**, February 16; **San Diego** Public Schools, February 17; **Oklahoma** Council for the Social Studies, **Oklahoma City**, February 21; **California** Council for the Social Studies, **Long Beach**, February 26-28; **El Paso [Texas]** Community College, March 7. For details, call (202) 296-6767 or (510) 704-0517.

From Desert and Oasis: *Arts of the People of Central Asia* includes 130 objects from seven countries, including furniture, jewelry and textiles. **Georgia** Museum of Art, **Athens**, February 21 through April 25.

Yemen: *In the Land of the Queen of Sheba* is the most comprehensive Western exhibition to date of the south Arabian nation's artistic heritage. Nearly 400 pieces are on loan from Yemeni museums. Institut du Monde Arabe, **Paris**, through February 28.

The Jewel and the Rose: *Art for Shah-Jahan*. 23 paintings, textiles and other objects stand for the blossoming that occurred under India's fifth Mughal emperor, builder of the Taj Mahal. Sackler Gallery, **Washington, D.C.**, through February.

In the Presence of the Gods: *Art from Ancient Sumer* displays 43 objects—including statues, vessels, tablets and reliefs—dedicated to gods and goddesses in the temples of ancient Iraq. Smart Museum of Art, **Chicago**, through March 8.

The Scent of Roses, the Gleam of Swords: *Islamic Art and Culture of the Mughal Period* presents miniatures, decorated arms, metalwork, ivory carvings, carpets and embroidery from the most powerful and refined culture to arise on the Indo-Pakistani subcontinent. Catalogue. State Museum for Ethnology, **Munich**, through April 13.

The Saudi Aramco Exhibit. Centered on the Arab-Islamic technical heritage, this permanent interactive, "learn-by-doing" scientific exhibit relates the historical background to today's petroleum exploration, production and transportation. **Dhahran, Saudi Arabia.**

Information is correct at press time, but please reconfirm dates and times before traveling. Readers are welcome to submit information for possible inclusion in this listing.

Woman's robe of silk-velvet ikat, Uzbekistan, 19th century.

Ikat: *Splendid Silks of Central Asia* displays vibrant textiles from Bukhara and Samarkand, drawn from the Guido Goldman Collection. Ikat, or resist-dye weaving, is made by tie-dyeing skeins of warp and/or weft threads prior to weaving. The result is a well-controlled pattern marked by slightly diffuse edges. The technique has been used in India, Indonesia, Japan, Africa and the Americas, but it was in 19th-century Bukhara (now part of Uzbekistan) that ikat experienced one of its greatest flowerings. Other Central Asian handcrafts flourished then as well, since industrial methods and goods were slow to appear in the region. In both cities, specialized guilds of Uzbeks, Tajiks and Jews each oversaw steps of the complex ikat process, thus lending the textiles social as well as aesthetic significance. But the arrival of synthetic dyes near century's end made ikat too time-consuming and expensive to continue on a large scale. More than 40 dazzling examples hang at the de Young Memorial Museum, **San Francisco**, through March 1.

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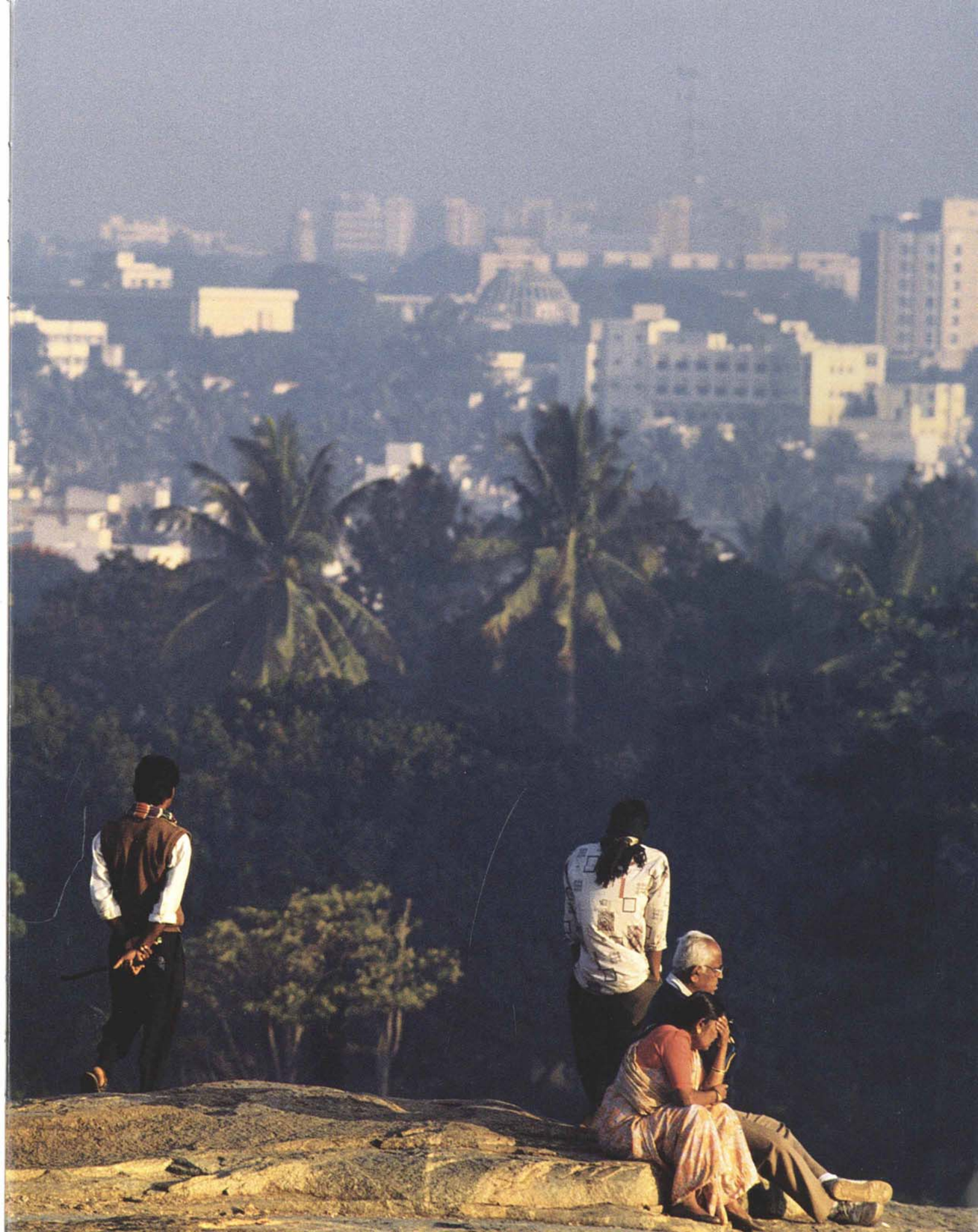

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