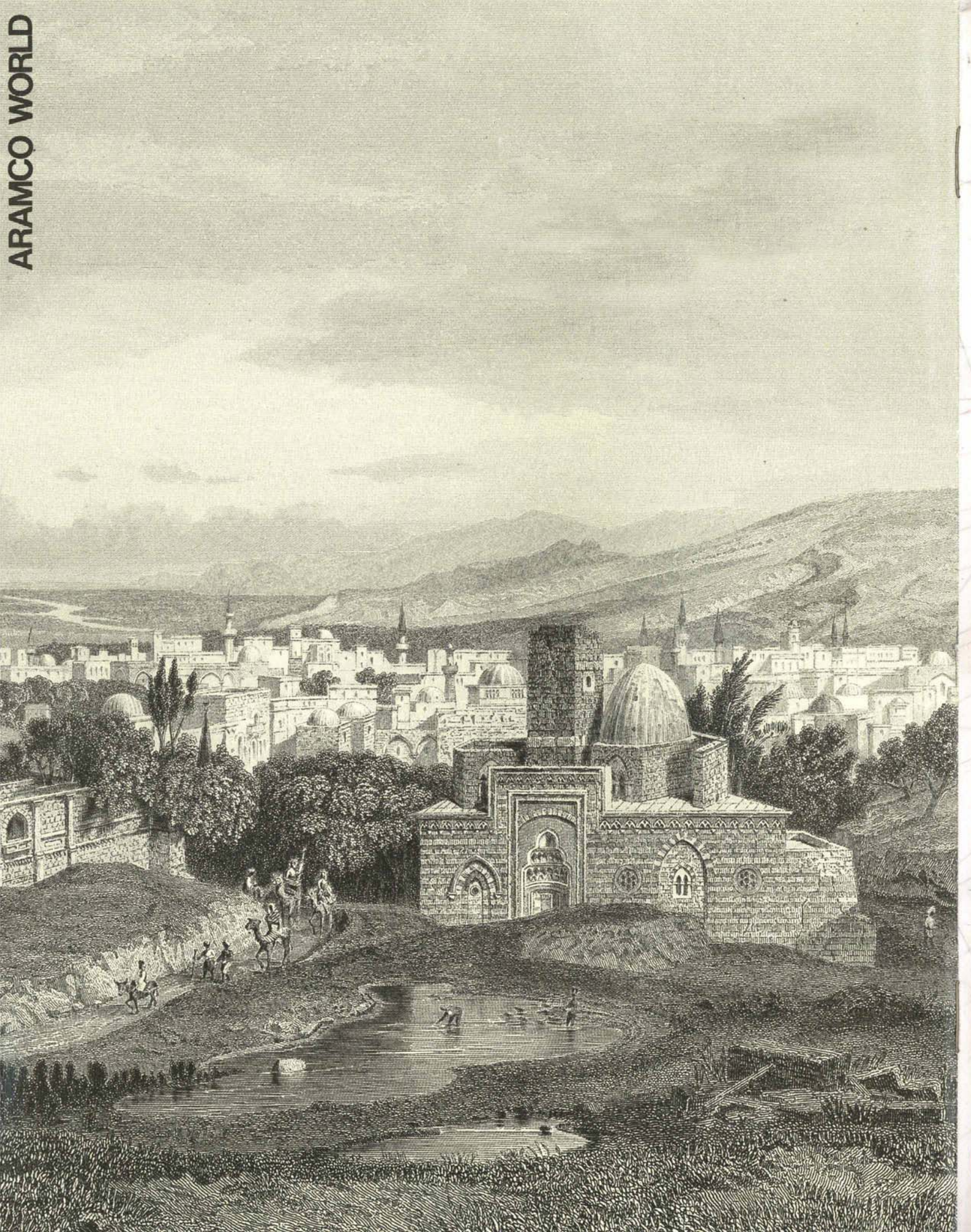
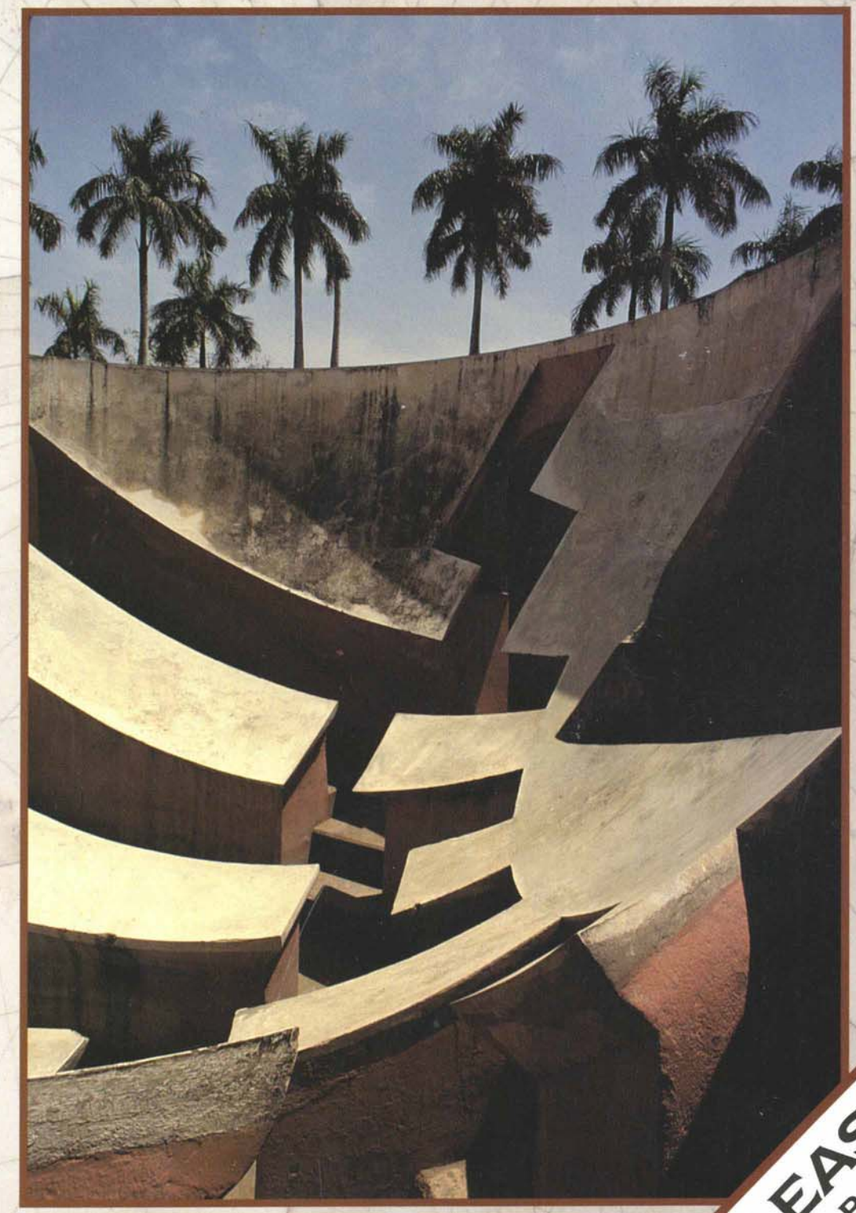
ARAMCO WORLD

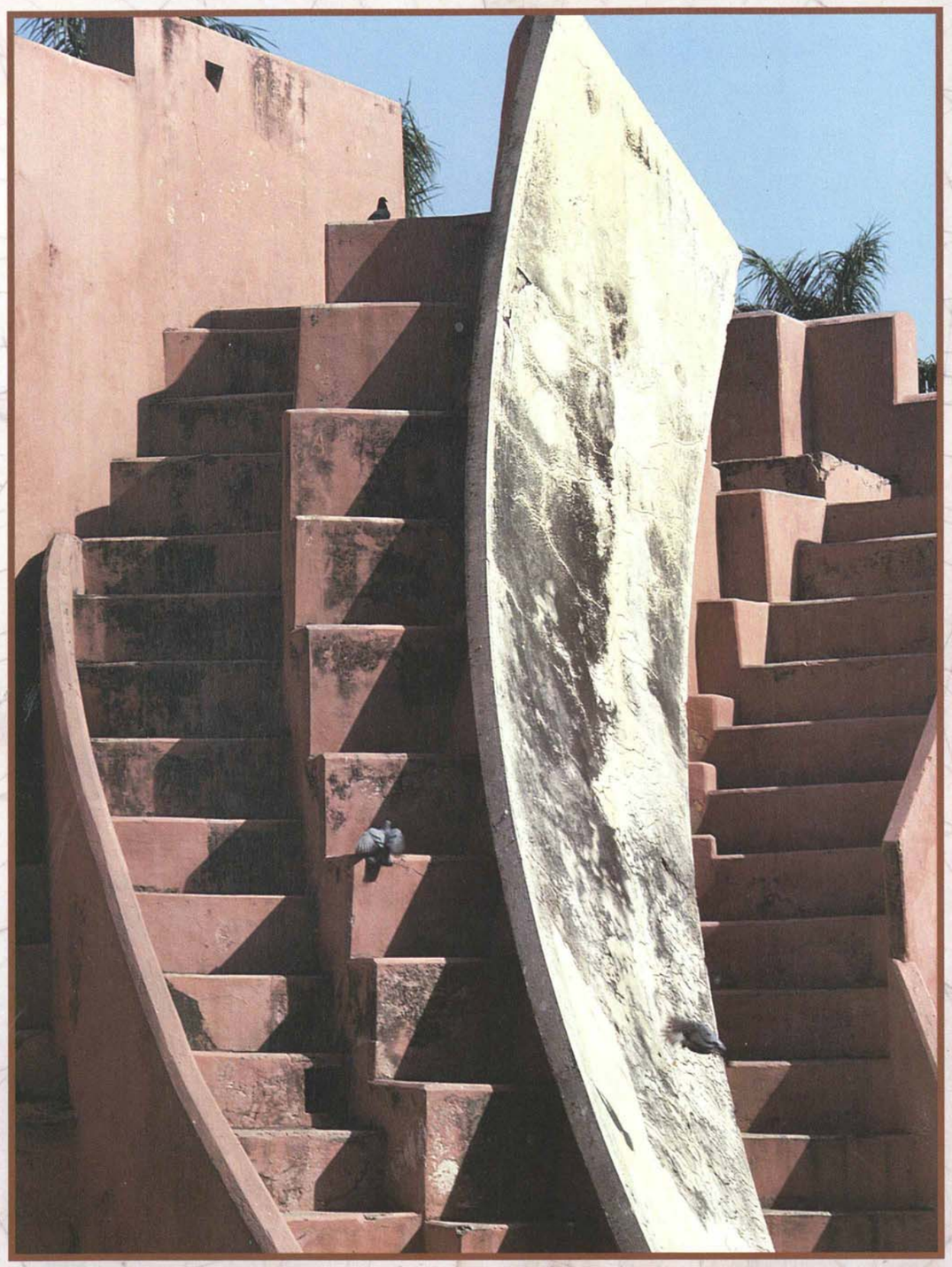


ARAMCO WORLD
MARCH-APRIL 1991



Jai Singh AND THE Jantar Mantar

MIDDLE EAST BIBLIOGRAPHY



Published by
Aramco Services Company,
9009 West Loop South,
Houston, Texas 77096

ISSN 1044-1891

Hamad A. Juraifani
PRESIDENT

Shafiq W. Kombargi
DIRECTOR, PUBLIC AFFAIRS

Ismail I. Nawwab
CONSULTING EDITOR

Robert Arndt
EDITOR

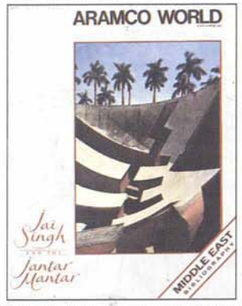
Robert W. Lebling, Jr.
ASSISTANT EDITOR

DESIGN AND PRODUCTION
Scurr, Barnes & Keenan Ltd.

PRINTED IN THE USA
Judd's, Incorporated
Shenandoah Division

Aramco World is distributed without charge to a limited number of readers with an interest in Aramco, the oil industry, or the history, culture, geography and economy of the Middle East.

Editorial correspondence should be addressed to
The Editor, Aramco World
Aramco Services Company,
Post Office Box 2106,
Houston, Texas 77252-2106, USA
Requests for subscriptions and changes of address should be sent to
Aramco World, Box 3725,
Escondido, California 92033-3725



Cover: Indian astronomer-maharaja Jai Singh built this *jai prakas yantra* in 1724 as part of a *jantar mantar*, or astronomical observatory. The two complementary concave hemispheres – the cut-out portions of one are the solid portions of the other – are marked with altitude and azimuth circles and were used to find the sun's position in the sky. The observer stood beneath the hemispheres to note where the shadow cast by two intersecting wires fell. Inset photo: Adam Wolfitt/Susan Griggs Agency; background: Lester Brooks.

◀ One of the curving scales of the *samrat yantra*, a giant sundial.

ARAMCO WORLD

VOL. 42 NO. 2 PUBLISHED BI-MONTHLY MARCH-APRIL 1991

GOLIATH AGAINST THE OIL SPILL

WRITTEN BY DONNA DRAKE
PHOTOGRAPHED BY CHRIS SALVO

Houston's sunny skies had turned cold, drizzly and overcast, perhaps to make the huge Russian bird feel at home.

As gray as the weather, the giant Antonov-124 let down almost centimeter by centimeter toward Houston Intercontinental Airport. Below, a tentative but fascinated crowd was growing. Mechanics, customs agents, baggage handlers – anyone with an airport badge – wanted to get as close to the Antonov as its crew would allow. The AN-124 is, after all, the world's largest transport aircraft, and this was its first commercial landing in the United States.

Half again the size of a Boeing 747, the four-engine AN-124 is the ultimate flying workhorse, rated for a payload of 150 metric tons (330,700 pounds) and with at least one record 171-ton lift in its logbook. In contrast, a 747 can carry only 100 metric tons (220,500 pounds) of cargo, and the US Air Force's big-lift C-5A, 110 tons (242,500). The Antonov's wings span 73.3 meters (240 feet), and its cavernous cargo hold measures 36 by 6.4 by 4.4 meters (118 by 21 by 14 feet). The only larger aircraft is the six-engine AN-225, of which only one copy has been built to haul the Soviet Union's space shuttle.

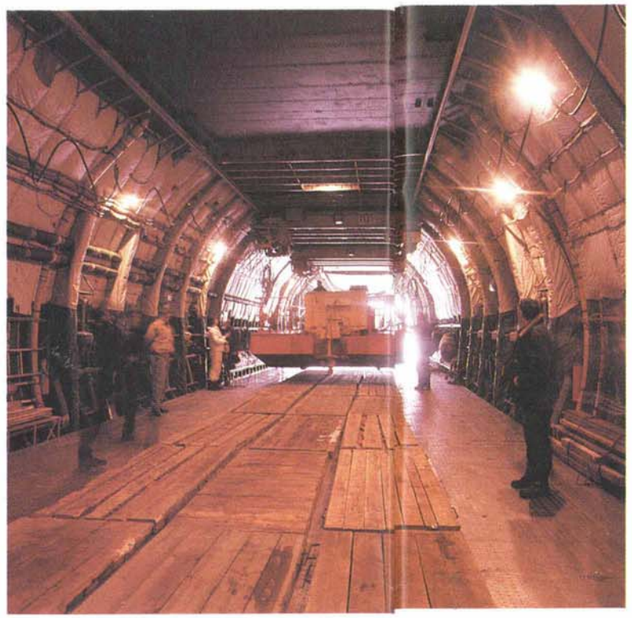
The USSR built the 1982-vintage Antonov for the same military reasons the US built its C-5A. But instead of supplying troops at war or on maneuvers, the flight of the Antonov into Houston last February assisted in a different kind of battle – the fight to contain the massive oil spills in the Arabian Gulf.

To support Saudi Aramco's spill-cleanup efforts, Houston-based Aramco Services Company (ASC) airshipped some 680 measured tons (more than 1.5 million volumetric pounds) of equipment to Saudi Arabia on commercial and chartered flights, finally turning to Air Foyle, a British-owned company with exclusive rights to charter the Antonov. Without the new spirit of cooperation between the superpowers, the parties agree, the US landing of the Soviet craft would never have occurred – and even *glasnost'* couldn't cut all the red tape. It took over a week to work through the communications barriers, and the original departure time from Kiev slipped several times while the crew awaited clearance from a central dispatch point in Moscow.

From Kiev, the Antonov flew to London, where it picked up aircraft brokers Charles Heather and Anthony Bauckham of World Aviation Group, as well as two US Air Force officers, who were to ensure that the craft kept to a closely defined flight path. Those four passengers had the uncommon experience of an Antonov takeoff: In the dark of a nearly windowless cabin, they rattled like beans in a can as the four huge engines ran up to their full 206,000 pounds of thrust and the crew let off the brakes.

Creature comforts, Heather noted, were not abundant aboard the Antonov. The only memorable one, apparently, was the crew's fare: sausages, salamis, cheeses and bread, hanging from the plane's bare ribs.

Thirteen hours and many headwinds later, the Antonov's 24 wheels – designed to land on lumpy fields, hard-packed snow or ice-covered swampland as well as concrete – stretched downward to support its controlled bellyflop onto the Houston runway.



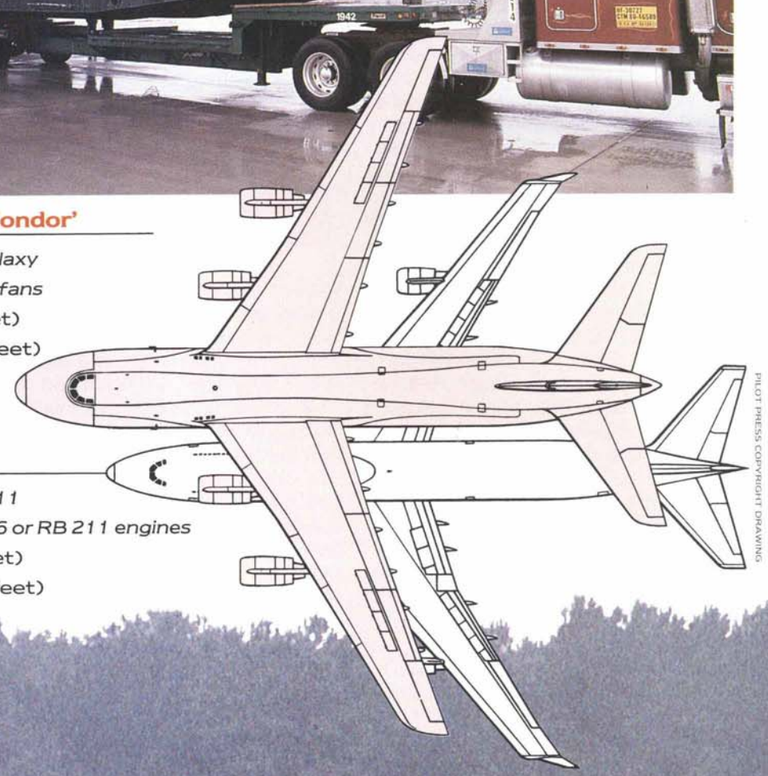
Traveling cranes in the Antonov's tunnel-like cargo bay lift a 12-meter-long oil-skimmer boat directly from its flatbed trailer and move it to a tie-down position.

Antonov AN-124 'Condor'

Confusion: *AN-225, Galaxy*
Power: *4xD-18T turbofans*
Span: *73.30m* (240 feet)
Length: *69.10m* (227 feet)

Boeing 747-400

Confusion: *A340, MD-11*
Power: *4xCF6 PW4256 or RB 211 engines*
Span: *64.92m* (213 feet)
Length: *70.66m* (232 feet)



Surrounding 747's and 707's became Cessnas; 18-wheelers loaded with containers and crates shrank to toys. From standard-size cockpit windows set in its giant fuselage, the beady-eyed Goliath stared at the wet, waiting bystanders. To their surprise, the Soviet crew welcomed them warmly, offering them free run of the curious craft. Sitting in the cockpit, visitors found themselves four stories off the ground. Were it parked in front of a building, the Antonov's tail fin would reach almost to the 10th floor.

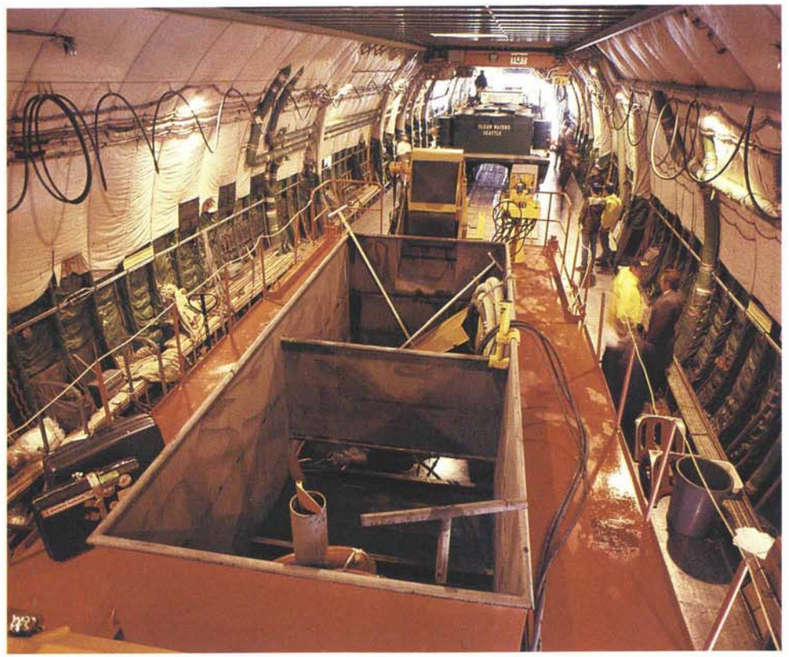
A heavy lifter by design, the Antonov-124 has none of the bright lights, shiny surfaces and avionic refinements of the 747's. Its dark interior appears to offer no palleting capability: In lieu of automatic clamps that rise up to lock freight into place, the titanium cargo deck sports only chain-and-strap cargo tie-downs. And while there are four electronic inertial navigation systems on board, well-used slide rules also lie on the navigator's table. Even the loading crew, wearing old wool caps and no uniforms, looks to have descended from a construction company's truck rather than from the plane that NATO dubbed "Condor," after the world's largest flying bird.

Yet the Antonov's simplicity is deceptive. The lack of automatic pallet-handling equipment is by choice: The power of this plane is in its payload, an advantage significantly reduced by bulky, heavy palleting systems. Though they are available on the Antonov, most customers prefer to have them removed to leave more space for the outsized cargoes they pay to ship.

And even without automatic loading, the Antonov provides unmatched door-to-door service for the kinds of job it was designed to do. Its unobstructed cargo deck is nearly twice the width of that on the next-largest charterable plane, and unlike any other sizable aircraft, it is equipped with four overhead traveling cranes which can lift up to 20,000 kilograms (44,100 pounds) of cargo into the hull at a time. The Antonov travels with its own loading crew of 15, who themselves work like machinery to place, secure and unload cargo. Ramps that unfold from both nose-cone and rear, along with the plane's ability to "kneel" on its nose gear to give the floor of the hold a 3.5-degree slope, virtually eliminate any need for the elevated platforms, cranes and extensive ground crews necessary to load and unload traditional freighters.

The AN-124 has hauled sheep from Australia to New Zealand, elephants and giraffes from Africa, a 150-head herd of cattle, palm trees, bridge girders, riverboats and pipe-laying and earth-moving equipment. On this trip, though, the cargo was critical oil-spill-fighting equipment. Awaiting the Antonov were two 12- by 4-meter (40- by 14-foot) skimmer boats, one from Seattle and another from Long Beach, California, as well as oil-containment boom from as far away as Nova Scotia. Bill Ruiz, who supervised the loading of ASC's freight, intentionally prepared far more cargo than he thought the Antonov could hold; in addition to the skimmers, six 20-cubic-meter (720-cubic-foot) containers, another 14 crates, and more than 40,000 meters (132,000 feet) of polyethylene beach-protection sheeting waited on the tarmac.

"And they loaded them, and they loaded them, and they loaded them." ASC President Hamad Juraifani, Traffic Supervisor Pat Hughes and Bill Ruiz of Air Terminal Operations marvel at the AN-124's capacity.



"Even after looking at the plane once it got here, I thought we had significantly more freight than it could handle," Ruiz said. Behind the skimmers came the containers, then the crates. "And they loaded them, and they loaded them, and they loaded them," he marveled. Its interior packed to the top, the Antonov swallowed every crate offered.

Intent on its work, the Soviet crew interacted little with the Aramco staff and onlookers, in part because of the language barrier. But *glasnost'* had arrived in Houston nonetheless. The Aramco Services employees understood that the Soviets shared their concern over the oil spill: When Ruiz explained to the Russian loadmaster what the cargo was for, he willingly shifted items already loaded to make room for two more crates. The Americans gave the crew some caps embroidered with the logo of ASC's oil-spill response team, and ASC Traffic Supervisor Pat Hughes received a US-USSR flag pin from the captain of the AN-124.

"We're doing something good here," was the way broker Charles Heather put it. "If we could have more instances where [military] equipment were being used for these purposes, the world would be a better place."

At 9:30 p.m., about eight hours after landing, the plane was loaded to the roof. Ruiz phoned Peter Thompson, his counterpart in Dhahran, Saudi Arabia, who was eager to line up the equipment and ground crew needed to handle the incoming shipment. "All you need is *several* flatbed trucks and maybe a forklift. They do everything else," Ruiz told him.

"You're kidding me!" Thompson replied.

"Nope. Just go out there with three people, tops. Then sit back and watch."

With the Houston leg of their job complete, the Russians went out for some Texas barbecue. By six the next morning, they were headed for a fuel stop at Shannon, Ireland, then on to Dhahran for another first-ever landing. Less than 17 hours after touching down in Houston, the Antonov was flying back out of US air space - but probably not for the last time.

Donna Drake is the editor of Focus, *ASC's employee newspaper.*

More Than Maps

High in the peaks of the southern Sinai Peninsula, a half moon illuminates the quiet valley a few rough kilometers from Mount Sinai. With the family and friends of Mahmoud Mansour, his Bedouin guide, Joe Hobbs drinks tea around the open fire. Talk rambles, turns to Hobbs's travels and, later, to the shape of the earth.

"It is flat," says Saleh Awad, Mansour's aging uncle, "How could it be night here, yet day in America?"

"No," counters the much younger Mansour. "Everyone knows it is round."

Hobbs, assistant professor of geography at the University of Missouri, sits quietly. Mansour asks his opinion on the issue.

"We have a theory," Hobbs says with measured diplomacy, "that it is round."

As one of a handful of Western experts on Egypt's deserts, Hobbs had come not to teach, but to listen. For seven months in 1989 he spoke with scores of Jabalia Bedouins throughout the ecologically unique High Sinai, gathering their advice for the Egyptian government on how to administer a 1000-square-kilometer (400-square-mile) national park in the Jabalia lands around Mount Sinai.

"The way that the Bedouins have been making a successful living off the desert for 6000 years should be an example to those who want to use the desert today," Hobbs says. Rapid development of tourism makes protection of fragile mountain ecosystems increasingly urgent, he explains: The Sinai hosts more than 450 species of plants, of which 27 are unique.

Among geographers, Hobbs's blend of fieldwork and advocacy makes him "both an anachronism and a man of the future," says Christopher Salter, chairman of the University of Missouri's department of geography. "As a man of the past, he fits right into that 19th-century mold of the geographer as explorer. He is contemporary because he combines expert knowledge with sensitivity and commitment to people, in a way that contributes to positive change."

When Hobbs lectures on the Middle East at the university, he paints a complex picture. He talks about farming, about foods, about oil, Islam, the Palestine question, and about endangered wildlife and the diverse human cultures in the region.

"Geography isn't just maps," he emphasizes. "It's the relationships among politics, culture, and resources – and it's perspectives."

A native of Texas, Hobbs first stepped into the desert at age 10, when his family moved to Dhahran, Saudi Arabia. "I was fired up," he recalls, "literally from the first instant."

One day not long after this move, he and a friend became lost while searching for desert lizards. A group of Bedouins gave them a place to sleep and, in the morning, accurate directions home. "They were so kind," he says, that their hospitality laid the foundation for Hobbs's enduring respect for desert people.

In 1986, after earning two degrees in fields concerning Egyptian wildlife and ecology, Hobbs turned his academic focus to people, living most of the year with the Ma'aza Bedouins of the mountains east of the Nile. His doctoral study, *Bedouin Life in the Egyptian Wilderness*, was published by the University of Texas at nearly the same time that Oxford University Press released *The Birds of Egypt*, a detailed, definitive volume that Hobbs co-authored. This year, a guidebook to the south Sinai is in the works. It will, Hobbs says, comprise more than maps.

Dick Doughty, formerly with Cairo Today, *is working on his master's degree in journalism at the University of Missouri in Columbia.*

WRITTEN AND PHOTOGRAPHED BY DICK DOUGHTY

EVENTS & EXHIBITIONS

CINCINNATI ART MUSEUM

Iranian earthenware seated lion, 12th/13th century.

The Art of Asia Galleries of the Cincinnati Art Museum serve as the primary focus of the museum during a major renovation under way until Fall 1992. New, more accessible exhibits, interpretive materials and changing displays have been added. Featured are golden objects from the Near East, important Nabataean sculpture from southern Jordan, and rare Islamic ceramics and paintings from the 12th and 13th centuries onward. About 50 objects are on view for the first time, including an earthenware bowl and a bronze rosewater bottle from 10th-century Iran. A recently acquired Ottoman Turkish gilt silver bowl from the late 16th century joins other prized examples of Islamic gold and silver work. A special display through December 1991 presents 18th- and 19th-century rugs from Turkey, the Caucasus and Iran. **Cincinnati [Ohio]** Art Museum, until Fall 1992.

Islamic Art and Patronage: *Selections from Kuwait*. More than 100 masterworks of Islamic art, drawn from one of the world's foremost private collections, that escaped the conflict in Kuwait. Kimbell Art Museum, **Fort Worth, Texas**, March 16 through May 12, 1991; Emory University Museum of Art & Archeology, **Atlanta, Georgia**, June 19 through September 22, 1991.

The Sculpture of Indonesia opens the Festival of Indonesia in the United States with 135 masterpieces from the classical eighth to 15th centuries of the world's most populous Muslim country. Museum of Fine Arts, **Houston**, through March 17, 1991; Metropolitan Museum of Art, **New York**, April 27 through August 18, 1991.

Yemen: *A Culture of Builders* takes an artistic look at the landscape, built form and ornamentation that characterize Yemeni architecture. Columbia University, **New York**, March 18 through May 10, 1991; University of New Mexico School of Architecture & Planning, **Albuquerque**, September 9 through October 18, 1991.

The Here and the Hereafter: *Images of Paradise in Islamic Art*. An exhibition of more than 50 carefully selected artworks demonstrating the cultural importance of the rich and complex Islamic vision of the afterlife. Also featured are gold-leaf inscriptions by American contemporary calligrapher Mohamed Zakariya. Dartmouth College's Hood Museum of Art, **Hanover, New Hampshire**, March 26 through May 19, 1991; The Asia Society Galleries, **New York**, June 27 through September 8, 1991.

Artful Deception: *The Craft of the Forger*. The fascinating stories behind two dozen fakes from The Walters Art Gallery's permanent collection, some of which were exhibited as genuine for years. The forgeries include three from the Middle East. **Columbia [South Carolina]** Museum of Art, March 31 through May 26, 1991. Elvejhem Museum of Art, University of Wisconsin at **Madison**, September 15 through November 10, 1991.

The Afghan Folio. Luke Powell's impressive photographs of Afghanistan, displayed as dye transfer prints. Manesh Hall, **Moscow**, April 1991; Handwerker Gallery, **Ithaca [New York]** College, March 19 through April 13, 1991.

Saints, Shrines and Pilgrimages. Objects, paintings and photographs from India, Iran, Turkey and other Islamic countries are used to explore Muslim piety and religious history. Harvard University's Arthur M. Sackler Museum, **Cambridge, Massachusetts**, April 6 through June 9, 1991.

Court Arts of Indonesia. Some 160 works of art dating from the eighth to the 20th century reflect the 1000-year traditions of the royal courts of Indonesia. **Dallas** Museum of Art, through April 7, 1991; Arthur M. Sackler Gallery, **Washington, D.C.**, May 19 through September 2, 1991.

Folk and Bazaar Paintings from India. This exhibition takes a look at several local traditions of Indian folk painting of the late 19th and 20th centuries, with works drawn from the museum's collection. Ashmolean Museum, **Oxford, England**, through April 7, 1991.

In Our Time: *The World as Seen by Magnum Photographers*. From the Middle East and elsewhere, 300 images by 60 first-rate photojournalists. Friends of Photography, **San Francisco**, through April 7, 1991; **Birmingham [Alabama]** Museum of Art, May 18 through July 7, 1991.

Brocade of the Pen: *The Art of Islamic Writing*. The exhibition demonstrates the use of "beautiful writing" on two- or three-dimensional objects and on architectural monuments. Michigan State University's Kresge Art Museum, **East Lansing**, through April 21, 1991.

Maurice Brazil Prendergast documents the stylistic evolution of the early modernist American painter, including Middle Eastern influences he absorbed late in his career. **Los Angeles** County Museum of Art, through April 22, 1991; The Phillips Collection, **Washington, D.C.**, May 18 through August 25, 1991.

Edward Lear: *Watercolors*. Lear's travels to the Eastern Mediterranean about 1850 are captured in these 42 watercolors, from the Runciman Collection. National Gallery, **Edinburgh, Scotland**, through April 28, 1991.

Mirror of Empire: *Dutch Marine Art of the Seventeenth Century* portrays Dutch trade and colonization efforts in the Islamic world and elsewhere. Oman, Egypt, Java and other locales are featured. **Toledo [Ohio]** Museum of Art, through April 28, 1991; **Los Angeles** County Museum of Art, May 30 through September 1, 1991.

Arms and Armor Galleries Reopening. The first major face-lift in 30 years for the Metropolitan Museum of Art's permanent arms and armor collection, featuring about 1000 objects of Islamic, European, American and Japanese origin that date from AD 600 to 1990. Metropolitan Museum of Art, **New York**, from May 11, 1991.

Greek Terracottas of the Hellenistic World: *The Coroplast's Art*. This exhibition features over 50 terracotta works of art illustrating the everyday life and spiritual expression of Hellenized communities in the Mediterranean, Asia Minor, Egypt and even the Kuwaiti island of Failaka in the Arabian Gulf, from the late fourth to the end of the first century BC. Harvard University's Arthur M. Sackler Museum, **Cambridge, Massachusetts**, May 25 through July 28, 1991.

Traditional Crafts of Saudi Arabia. The John Topham collection of weavings, jewelry, a Bedouin tent, and metal, wooden and leather handicraft objects. Texas Memorial Museum, **Austin**, through May 12, 1991.

Antoin Sevruguin: *Photographs of Iran*. Portraits of rulers, citizens, tourists and mendicants in the Iran between the 1880's and the 1920's, made by the country's most successful commercial photographer of the time. Arthur M. Sackler Gallery, **Washington, D.C.**, through May 26, 1991.

Mamluk and Ottoman Carpets. A major exhibition of the museum's unparalleled but little-known collection of Mamluk and Ottoman carpets. The Textile Museum, **Washington, D.C.**, June 1, 1991 through Janurary 5, 1992.

Trailing the Tiger – To Golden Cloths of Sumatra's Minangkabau. Some 59 examples of the striking golden cloth woven in the highlands of West Sumatra, along with jewelry, photographs and music. The Textile Museum, **Washington D.C.**, through June 9, 1991.

Egypt: *The Search for Immortality*. The ancient Egyptian death cult and concepts of eternity are illustrated in a special exhibit of some 130 treasures covering four centuries. Roemer- und Pelizaeus Museum, **Hildesheim, Germany**, through June 16, 1991.

Gold of Africa: *Jewelry and Ornaments from Ghana, Côte d'Ivoire, Mali, and Senegal*. More than 150 spectacular objects are evidence of highly developed skills and tastes in the West Africa of the 19th and 20th centuries. Art Institute of **Chicago**, June 29 through August 25, 1991.

Another Egypt: *Coptic Christians at Thebes*. Objects from the daily lives of Egyptians who, from the seventh to eighth centuries, lived in the shadow of pharaonic temples and ruins on the west bank of Thebes (modern Luxor). The Oriental Institute Museum, **Chicago**, through June 30, 1991.

Palestinian Costume. Richly ornamented traditional costumes, headdresses and jewelry of Palestinian villagers and Bedouins. Photographs provide context. Museum of Mankind, **London**, until August 1991.

The Arts of the Persian World: *The A. Soudavar Collection*. Paintings, drawings, calligraphy, manuscripts and metalwork trace the evolution of Persian art and its impact on other cultures. The exhibition also emphasizes the impact of Islam and the Mongol invasions on Persian culture. **Los Angeles** County Museum of Art, September 5 through November 10, 1991.

Irving Penn Master Images. Ethnographic images from Morocco are included in this 120-photograph exhibition by the master photographer. **Los Angeles** County Museum of Art, from September 5 through November 17, 1991.

Armenian Art: *3000 Years of History*. A panoramic look at artistic achievements over the centuries. The Armenian Museum, **Paris**, Thursdays and Sundays through 1991.

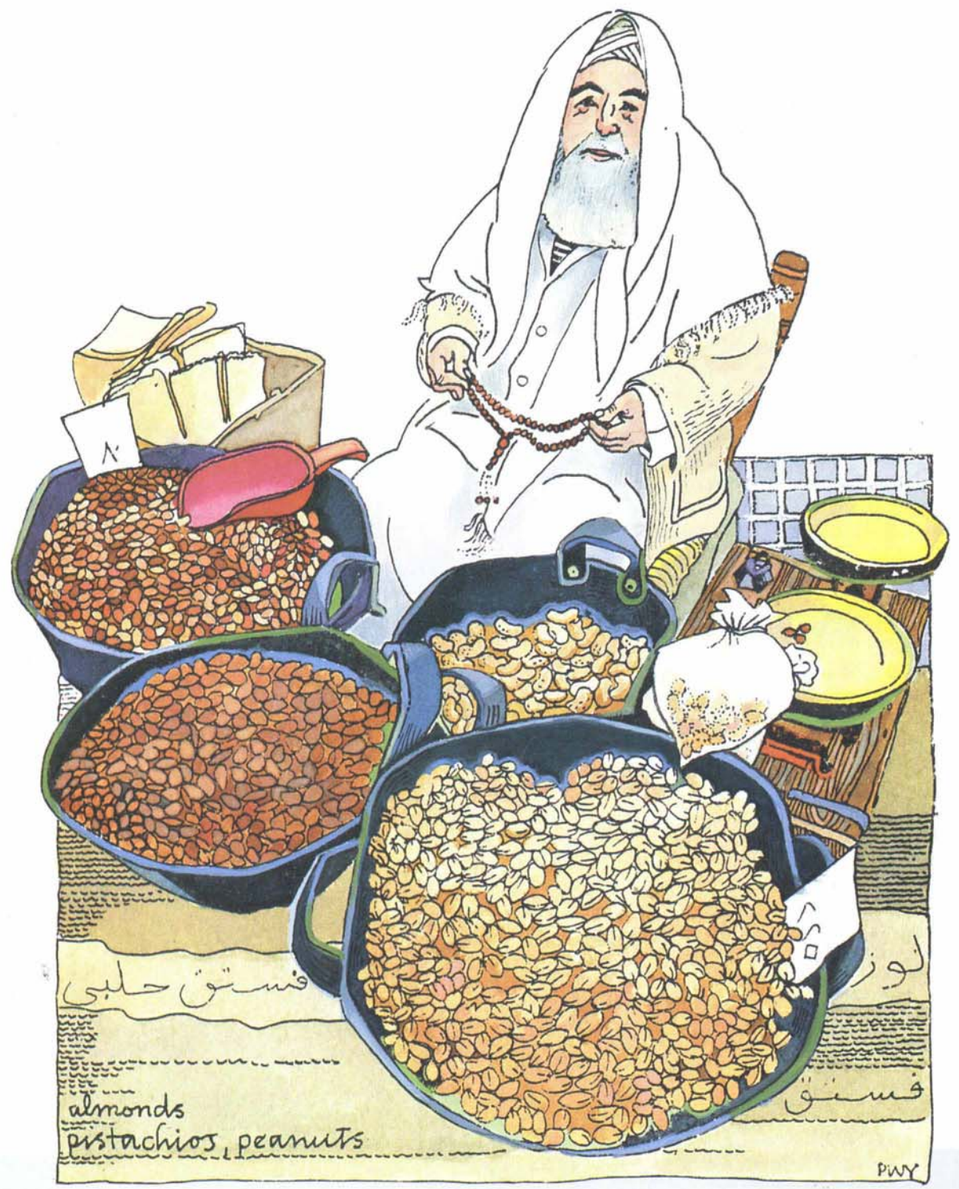
Pre-Islamic Arabia. A preview of pre-Islamic antiquities from the Arabian Peninsula, to be exhibited later at the Louvre. Featured are pre-Islamic artworks from Yemen, alabaster sculptures, ex-voto and funeral portraits from Palmyra, Imru al-Qays epitaphs, ceramics, and other objects. Institut du Monde Arabe, **Paris**, until 1993.

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

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

ON THE STREETS OF

DAMASCUS



WRITTEN BY ANTHONY B. TOTH ILLUSTRATED BY PENNY WILLIAMS-YAQUB

ORIGINAL PHOTOGRAPHY BY ANTHONY B. TOTH

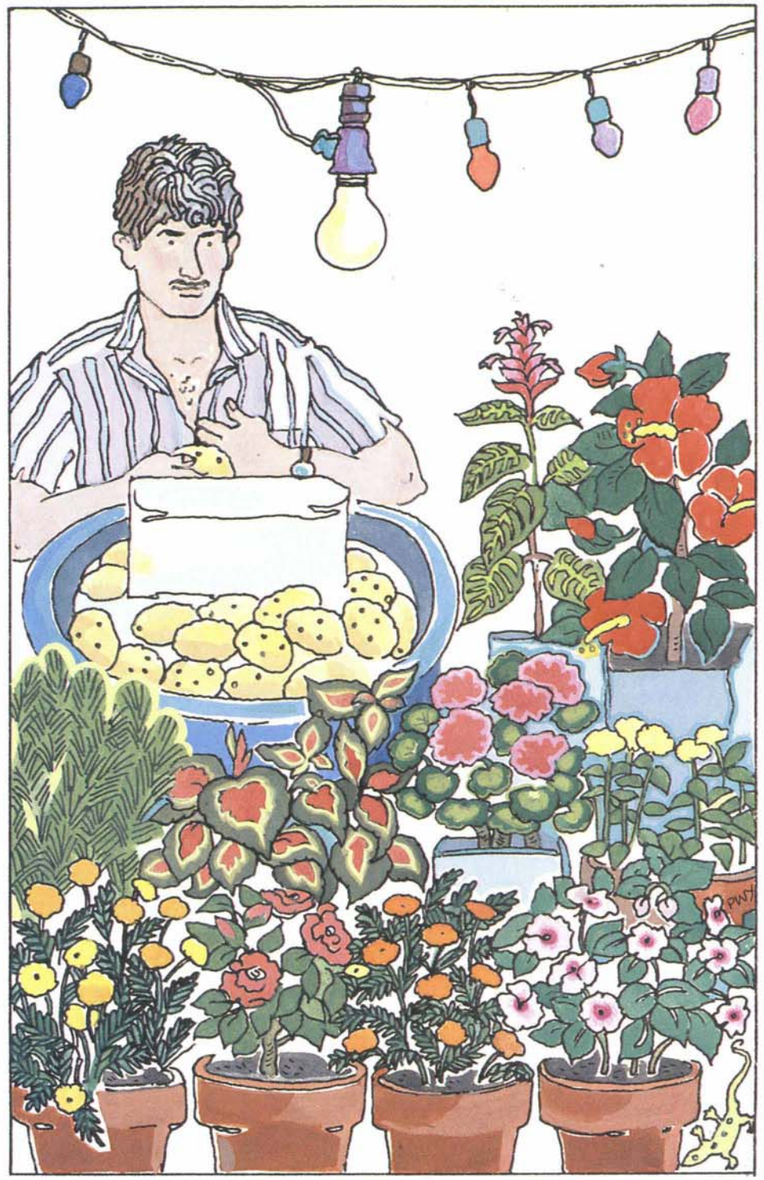
The summer sunset pours a soft apricot light on the walls and rooftops of what is probably the world's oldest continuously inhabited city. Viewed from the cool heights of Jabal Qasiyun, there is nothing remarkable about the streets of Damascus: They slice through modern neighborhoods at the clean angles of baked *kibbah* in a pan, and dwindle into a maze of alleyways in the ancient quarters.

It is when you descend from the hilltop and begin to walk the streets and alleys of Syria's capital that they reveal themselves as an ever-changing, ever-peopled stage upon which the city displays its unique character. On busy avenues and quiet, shaded lanes, Damascus buys and sells, toils and plays, celebrates life and mourns its passing. And with each season come changes in the colors, moods and rhythms of the city's streets.

The onset of dusk leaves buildings and boulevards below blurred in blues and grays as a young snack seller gets ready for the evening's work. His small wooden box is crammed with gum, candy bars and cigarettes for the carloads of customers to come. Nearby, *falafil* vendors fire up their cooking oil; steam begins to rise from the huge cauldrons on the bean sellers' carts.

From downtown, this highest street in the city glitters like a multicolored necklace strung across Jabal Qasiyun. Lights flash on the amusement rides and restaurants, music blasts from speakers hoarse from overwork, children beg their parents to buy them cotton candy dyed colors not found in nature. Picnickers and promenaders enjoy the view and breathe deeply the air that is invariably described as cooler and cleaner than the city's.

Damascenes relish their summer evenings outdoors. The city's parks come alive after the sun goes down, and the business districts fill with window-shoppers. Street vendors, their carts bright under portable gas lamps, ply the crowds with freshly boiled corn, *baleela* – a kind of bean eaten as a snack – or *ka'ak*, a term used for several kinds of baked goods. Chilled *sabara*, cactus fruit, is gingerly peeled for customers



flowers and prickly pears ••• صبر و زهور

at stands made as inviting as an oasis by rows of potted greenery and cheerful strings of lights.

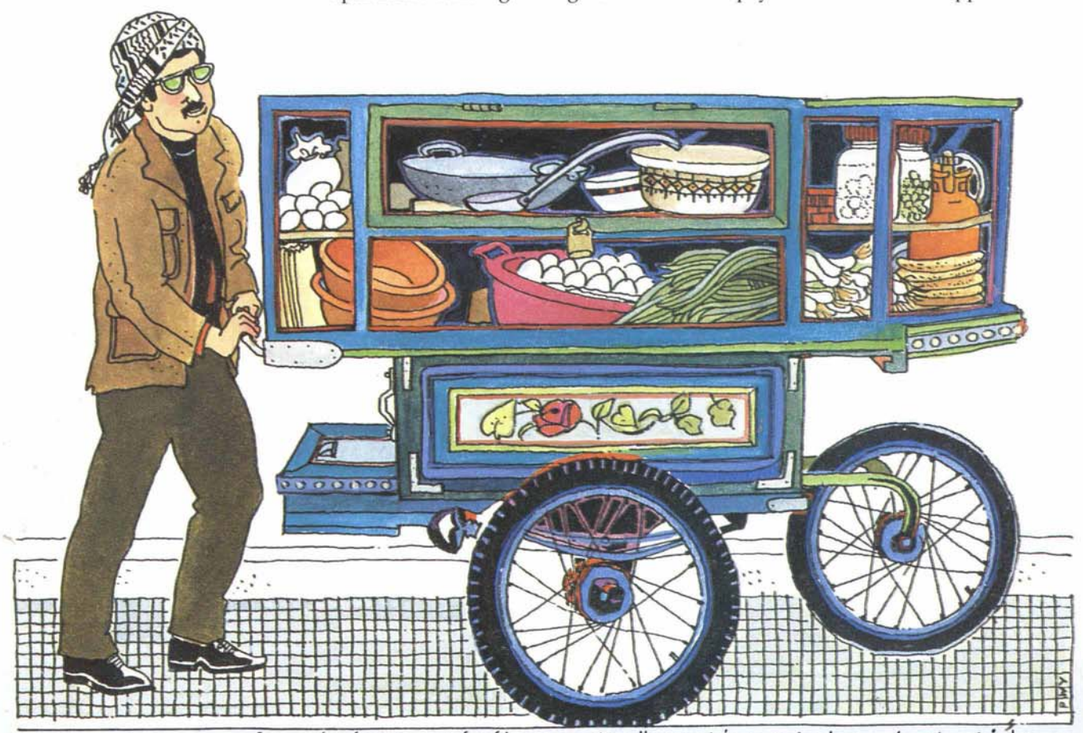
Young people, dressed and coiffed to kill, stroll and gather in clusters, or cruise around Jahiz Park and Abu Rummana in long, slow caravans of shiny cars. Like teenagers around the world, they squeal their tires and honk their horns in the impatient exuberance of youth.

At dinner time, when neighborhood streets are left to the prowling cats, the stillness is broken by a speeding train of cars – horns blaring non-stop, lights flashing – festooned with yards of meticulously applied ribbon and arrangements of gladiolus and carnation. A young couple has been married. As the cars barrel along, noses poke through the curtains and heads stick out of apartment windows to investigate the commotion. Photographers hanging precariously from the lead car record on film and 'videotape the joyful noises and the decked-out cars of the wedding party.

The sun rises on streets empty of strollers, vendors, revelers and even cats. A hollow clip-clop echoes off the modern apartment buildings lining a street in the Malki neighborhood. A man and a mule come into view, a produce vendor riding into the city from his farm. Every few seconds he yells, monotonously naming his wares, The old man and his mule carry potatoes and onions past Mazdas and BMWs. Soon, the men who wash cars will appear with their buckets and rags; they do valiant battle every workday with the eternal Damascus dust, keeping the ephemeral chariots shiny.

Schoolchildren soon appear, some walking in boisterous groups, others waiting for buses. A man gathers delicate, sweet-scented jasmine blossoms into his cupped hand as he walks along the sidewalk. The corner greengrocer opens; his delivery boys load the big baskets on their bikes with flat bread, olives, onions and perhaps even a watermelon. Then they tear off on their rounds, zooming like racers around corners and coasting downhill, no-handed and nonchalant. Hanging on walls outside barber shops and real-estate offices are cages with twittering songbirds.

Nearby, a scribe has set up table, chair and typewriter on a sidewalk overlooking the Tora River. Early-morning visa seekers pay him to fill out their applications and to



green onions, eggs, bread, cheese and olives. بصل أخضر، بيض، خبز، جبنه وزيتون

translate documents. Catering to the same clientele, another sidewalk entrepreneur down the street offers photocopying and photography services while you wait.

The best place for open-air photography, though, is Marja Square, in the heart of the city. For those requiring photographs for the nearby government offices, there are old photographers with their equally venerable wooden cameras. The first three fingers of their right hands are stained deep brown by countless immersions in the tray of developer, which they keep inside the long bellows of their cameras. Some of them surely remember when streetcars, camels and Model-A Fords crowded the square, instead of today's Eastern European buses and taxis built in Japan.

Marja Square is also aswarm with tourists – "local" tourists from elsewhere in Syria as well as travelers from abroad. Both varieties have their pictures taken in front of the column commemorating the construction of the Hijaz telegraph line.

The sidewalks around Marja are thick with goods and services on offer: shoeshines, nuts and dried seeds, lottery tickets, grilled meats, coffee and watches.

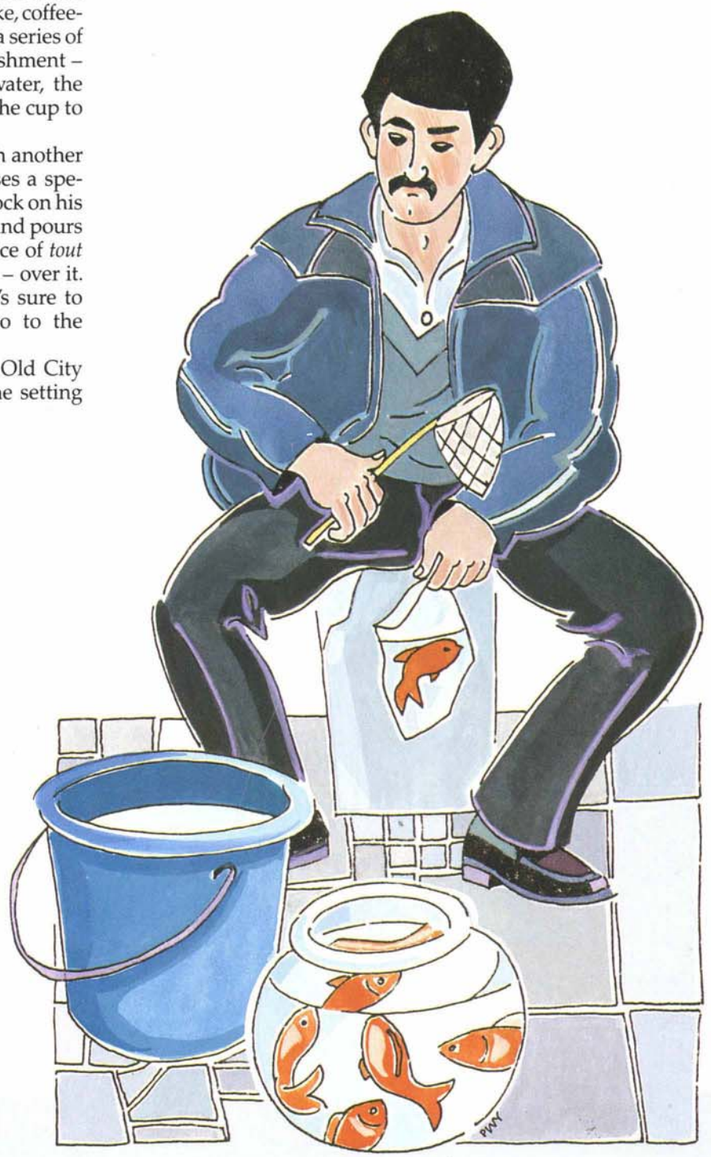
As the blazing summer sun rises to its apex, much of the city shuts down and catches its breath. Mad dogs, Englishmen and any others braving the noonday sun may start to think about quenching their thirst. In Damascus, there are gratefully many options.

vendor of folded paper snakes ... بياع أفاعي من ورق

Streetside stands selling fresh-squeezed juices abound. The fruit of the season serves as its own advertisement, hung in mesh bags out front – oranges, grapefruit, apples, pomegranates. At the entrance to Suq Hamadiya, the main market area of the Old City, the *sawwas*, or *sous*-seller, signals his presence with the cling-clanging of the shallow brass bowls he holds in one hand, and the tinkle of ornamental coins on the large metal tank slung on his back. The *sous*, a bittersweet, licorice-like, coffee-colored drink, is dispensed with a series of showy flourishes, rituals of refreshment – the rinsing of the glass with water, the pouring, the formal handing of the cup to the customer.

A simpler routine obtains with another Damascus drink. The vendor uses a special tool to shave ice off a large block on his cart. He puts the ice into a glass and pours the rich, syrupy, deep-purple juice of *tout shami* – the Damascus mulberry – over it. For decoration or lagniappe, he's sure to offer a whole mulberry or two to the thirsty customer.

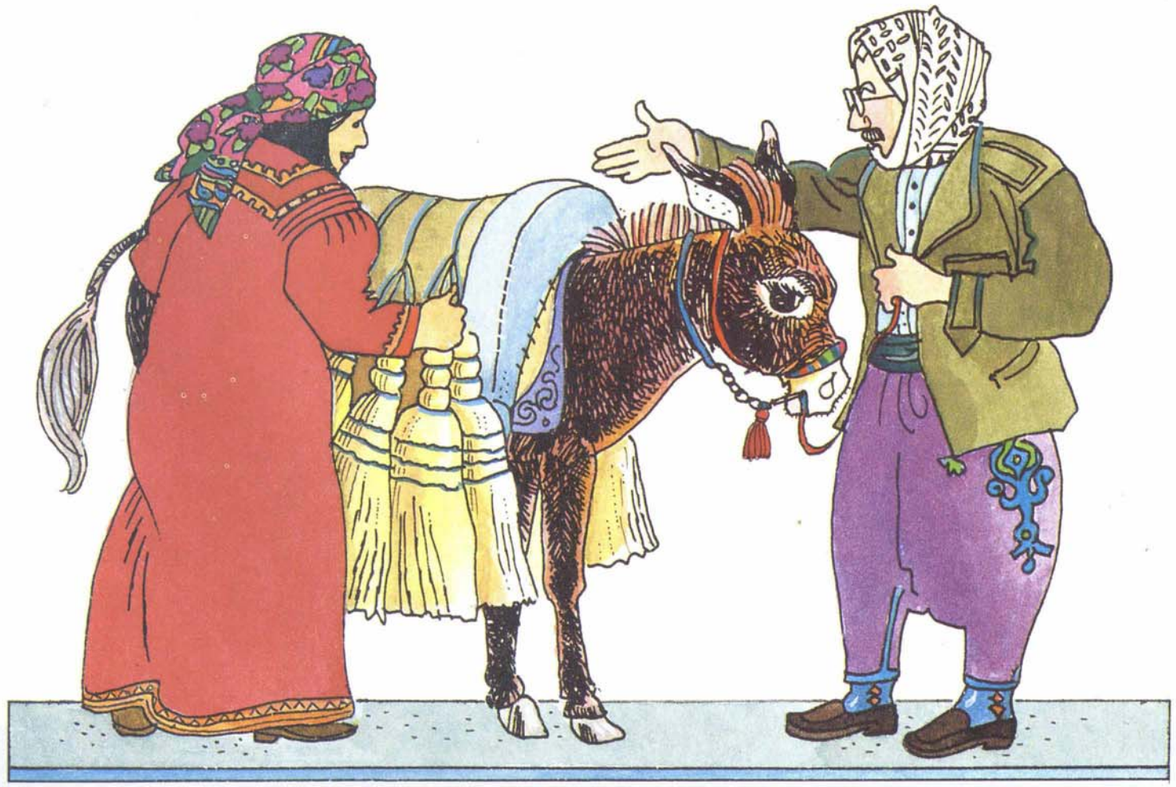
The streets and alleys of the Old City begin to bustle once again as the setting sun loses its strength and the cool shadows lengthen. Merchants pull out chairs, and some relax with a water pipe and a cup of tea. Others set backgammon boards on small tables in front of their stores and begin to play. To the unaccustomed observer the swift rolls of the dice and the clacking of the wooden pieces blur into a confusing dance of experienced hands.



gold fish seller ✲ السمك الذ هبي

At the produce markets, sharp-eyed shoppers seek out the best vegetables – and the best prices – for dinner, complaining scornfully about bruised tomatoes and wilted parsley, haggling over prices and eventually loading up their bags. The songs of the hawkers rise above the dust and the mingled smells of mint and garlic and apricots (See *Aramco World*, September-October 1971).

The rhythm of the street quickens. Short, stout mothers in headscarves and dark overcoats, all shoulders and hips, jostle past the unwary. Ten-year-old cyclists on black-framed bikes made in China weave their way through the pedestrian traffic, whistling like birds to warn those in their way. Horsedrawn carts with big wooden wheels haul sand to a construction site or waste sawdust from a furniture-maker's shop. Shopkeepers spot passing tourists and beckon them with a staccato spiel in any likely language: "ComeinsideJustlookWehavecaftanstablecarpetclothssoldbrassWhatyouwant?" Pint-sized hawkers wail the brand names of cigarettes. A man selling plastic flutes plays nimble trills while another loudly snaps the plastic tablecloths he offers, to show their quality. Blind men with beautiful voices follow their canes as they recite praises to God and sell boxes of matches. Boys carrying circular stainless-steel trays of coffee and tea to customers around the *suq* rush out of closet-sized teashops wedged between buildings. Suddenly, a dark shape slithers near your feet; you gasp and jump and your heart races, but it's only a toy snake made of cleverly folded paper and sold for a few Syrian pounds by Afghan boys. The perfume vendors in front of the Umayyad Mosque dispense a hundred scents, some as ancient as the trade routes from the East, others as modern as yesterday's Paris creation.



bargaining for brooms in Damascus · مكانس مكان مكان

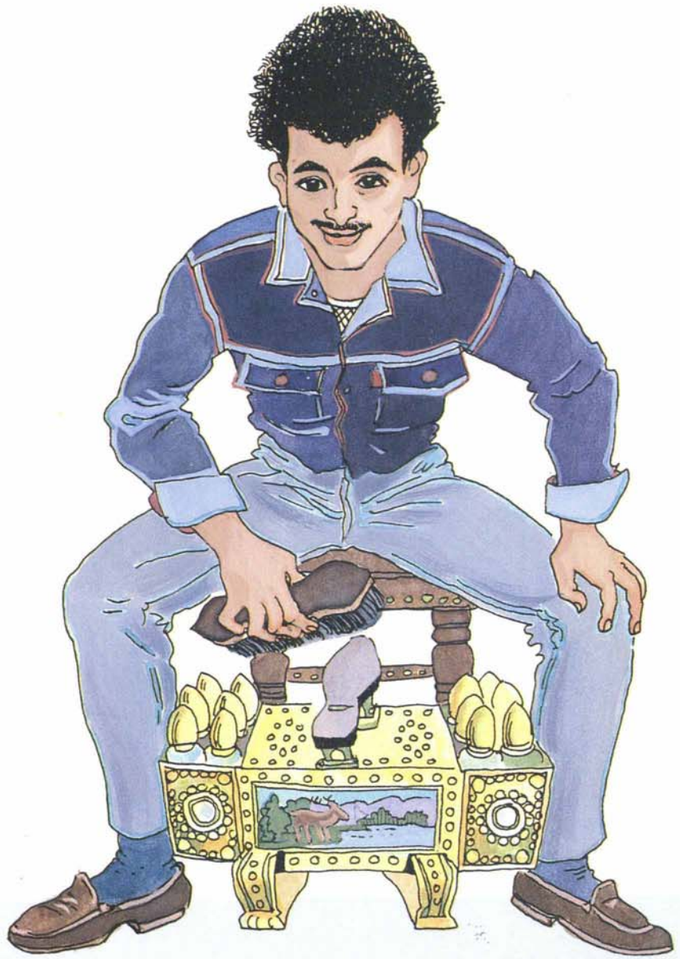
By the time the day's final call to prayer fades away, the market streets are calm at last, but the Old City rises early the next morning with more bustle, more color, more noise. Porters sit on their handtrucks in Buzoriya and wait for something to haul. An old man fills the water bag on his back in the fountain of the courtyard at the Azem School, now a handicraft and antique shop. He walks down the narrow streets and does his ineffectual best to sprinkle down the day's rising dust. There used to be many like him in the city, shouting *"Wa'a ijrayk!"* – "Watch your feet!" – paid and sometimes fed by the merchants in front of whose shops they worked. Shopkeepers these days tend to do their own sprinkling, and this water carrier may be the last practitioner of a dying trade.

Clothing vendors hang nightgowns, scarves, blouses and hats on their already overflowing carts. Long-handled, coal-fired pot in hand, a young man pours early-morning passersby a hot cup of Turkish coffee. Beans are breakfast food in Damascus, and vendors offer steamy bowlfuls, seasoned with lemon, salt and cumin. A middle-aged man delivers papers on his bicycle, folding the news of the day into a tight projectile and tossing it expertly onto third-floor balconies.

Children pile onto school buses; their parents rush to work. Taxis decorated with lights and mirrors, mini-buses decked with stickers and ostrich plumes, bicycles, scooters, pedestrians – all vie for a piece of the road while traffic policemen whistle and wave and try to untangle the knots that form at intersections.

The workaday cacophony abates during the great feast days of the Islamic year, 'Id al-Fitr and 'Id al-Adha. Those are times for family, for cooking and eating, and for visiting loved ones.

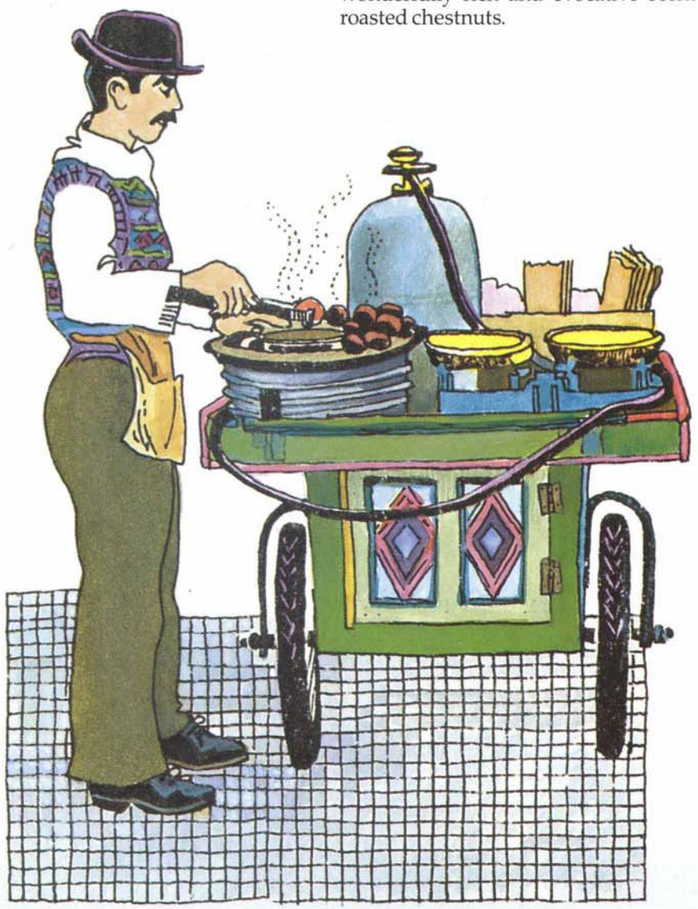
In some neighborhoods, during the festive periods, children rule the streets. Only candy and toy stores are open as youngsters, turned out in frilly dresses and pressed pants, swarm at knee level. Swings and other rides are set up around Jahiz Park, in Salhiya and near the Umayyad Mosque. For a few coins a child can buy a fistful of sweets, ride a pony or a



toy car, purchase a doll and swing fast and high amidst the joyful shrieks of companions. They may even see a roaming troupe of entertainers, chanting rhymes and dressed in costume.

In the streets of the Christian quarter of the Old City, Easter is the big event of the year. Syrian versions of Easter bonnets are tied on young heads and the narrow streets fill with colorful crowds, seeing and being seen.

Like holidays, but for different reasons, winter too chases people off the streets. The photographers at Marja pack up for the season, their chemicals and their old hands equally ineffective in the chill. There will be no more *sous*, corn on the cob or *sabbara* until next summer, but a few hardy vendors fire up small coal stoves and gas lamps and fill the air with the wonderfully rich and evocative scent of roasted chestnuts.



hot-roasted chestnuts كستنا مشوية

And because snow is not common in the city, impromptu battles of exceptional enthusiasm break out among schoolchildren when a few inches dust the slopes of Jabal Qasiyun. Even the ubiquitous young guards in front of embassies and government buildings set aside their guns and awkwardly toss snow bombs at their colleagues across the street.

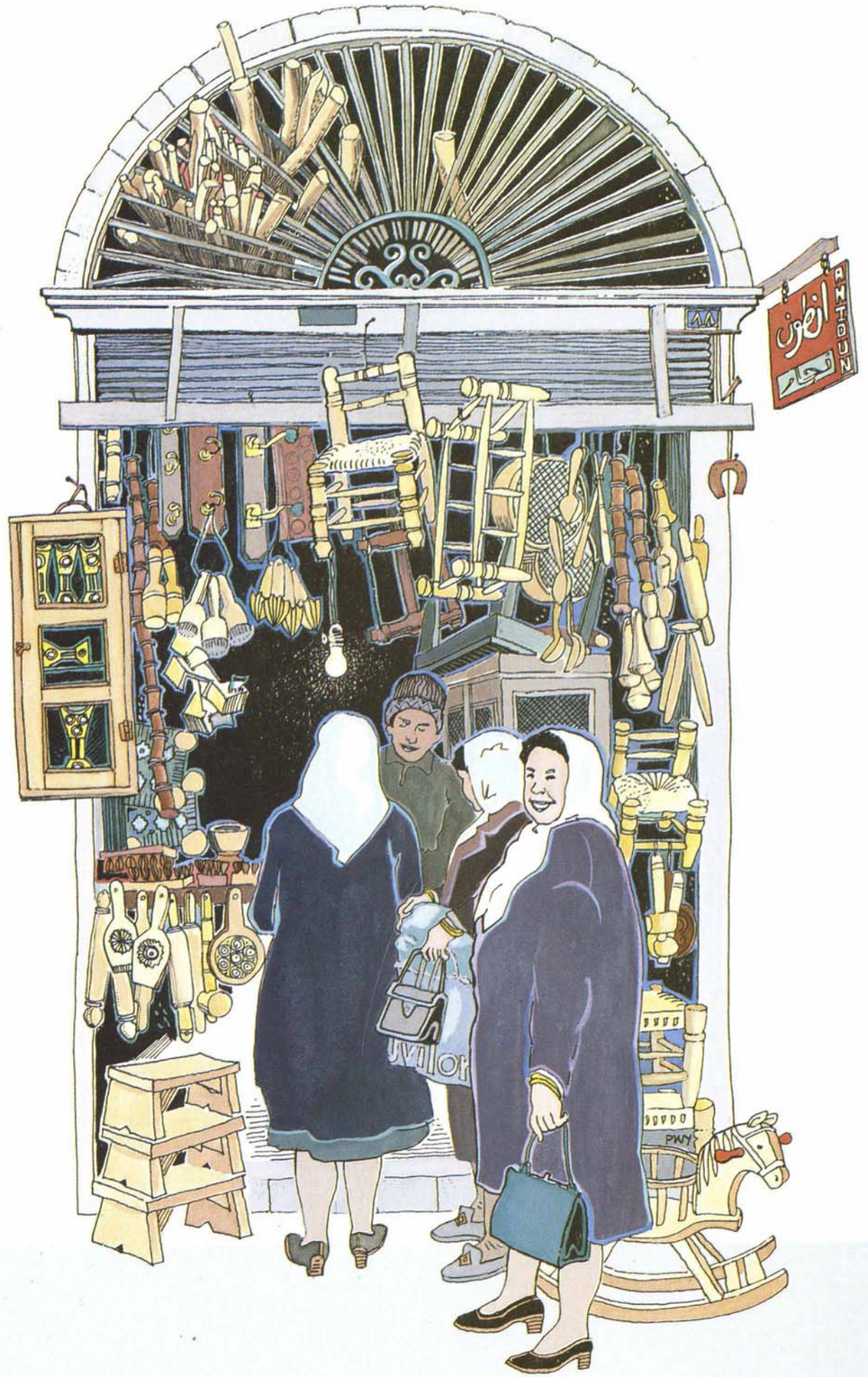
And when there is no snow in Damascus itself, some playful souls drive a half hour to Bludan, a resort town in the mountains near Lebanon. After frolicking in the snowy heights, they may build a snowman on their car and drive back to the city, sporting what remains of their wintry hood ornament.

Spring brings warmth back to the city, and Damascenes are quick to resume picnicking (See *Aramco World*, March-April 1979). Blankets spread in blossoming parks and orchards are occupied by barefoot grandmothers eating stuffed grape leaves, and children play soccer non-stop. Just five minutes by car from the dusty, narrow streets of the Old City are the tree-canopied byways of the Ghuta, the green-belt around Damascus. As the weeks of springtime pass, apple, cherry, apricot and pear trees take turns at center stage in a wonderland of pale color and light.

Flowers transform the streets of the city itself. Florists specialize in elaborate arrangements, cut-flower explosions of color on wood-and-chicken-wire frames, set proudly in front of their shops. Live flowers, too, are popular. Vendors cart fragrant Damascus roses potted in large olive-oil tins, and grape vines whose long stems are looped into living hoops.

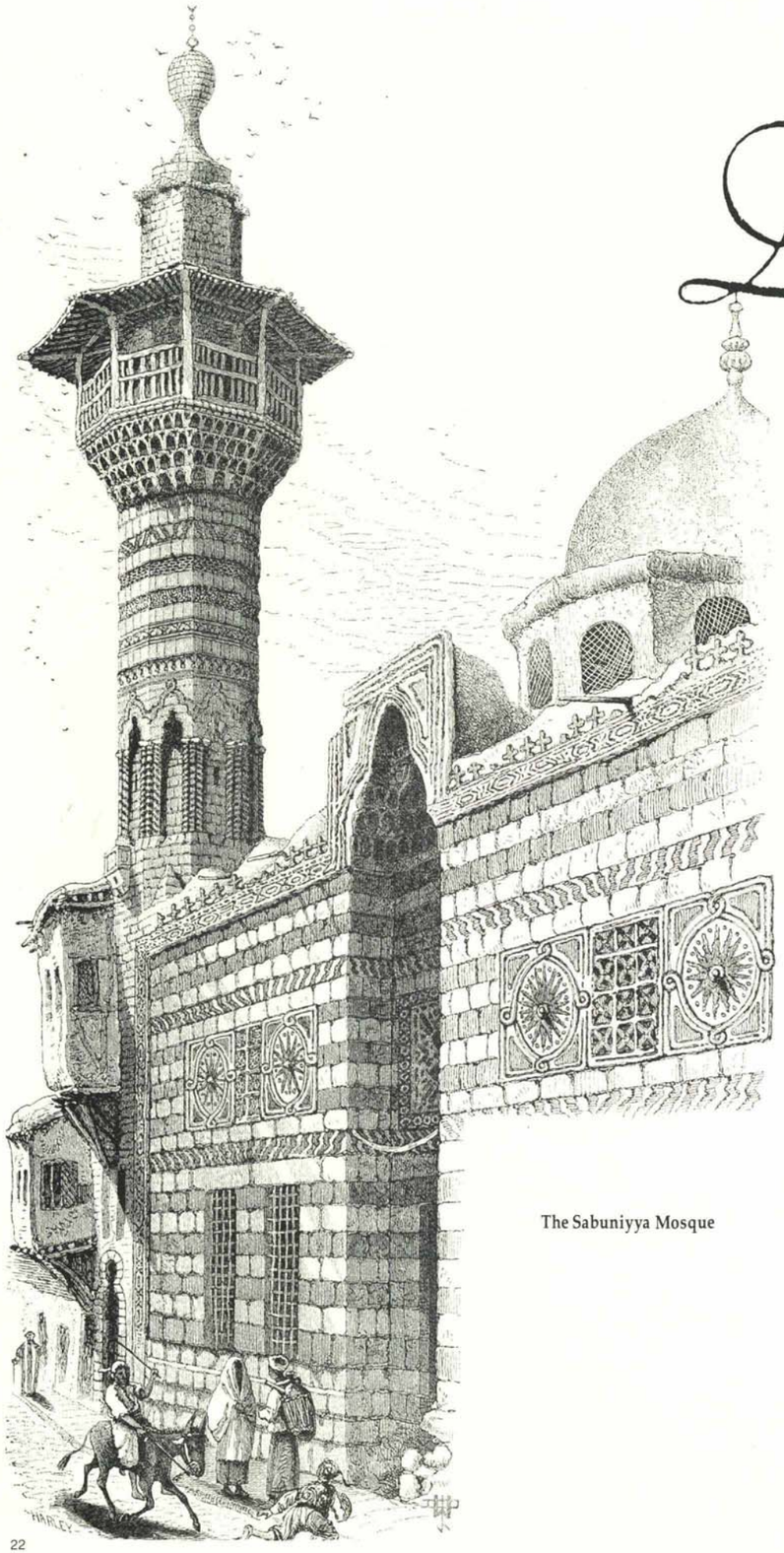
Flowers are for weddings, for parties, for funerals, for love and hope, for sadness and regret. From around a corner a white van slowly pulls onto a main street, followed by a long line of cars filled with solemn passengers. Out of the loudspeaker on the van's roof comes a plaintive chant; inside, a flower-draped casket is visible. The procession winds slowly toward a cemetery, a final ride for one Damascene through the streets of his city, past rows of trees and budding branches.

Anthony B. Toth spent much of his 18 months in Damascus exploring the city's vibrant and varied street life. He now lives in Doha, Qatar.



VISIONS OF
DAMASCUS

WRITTEN BY LYNN TEO SIMARSKI



The Sabuniyya Mosque

Damascus, possibly the oldest continuously inhabited city still standing, has inspired legends, visions, and literary tributes for millennia. Centuries of visitors, from the early Arab geographers to European merchants and travelers, have sketched the spiritual and natural dimensions of Damascus, honored as "The Garden of the World."

Despite its long history, the city today still seems as freshly-scented, resplendent and sensual as when the traveler Ibn Jubayr beheld her in the 12th century, "ringed by her orchards as a halo rings the moon." Behind Damascus rises rugged Mt. Qasiyun, with the ancient suburb of Salihiya clinging to its slopes; below, on the plain, stretch the old city and the Ghuta, a flaring skirt of orchards. Canals flow with the mountain water of the Barada River, threading through the city to the gardens beyond. Night transforms the panorama, swept by soft jasmine-scented breezes, into a scatterlng of star-like lights across the plain, dimming into the dark oasis beyond. At a turning point in modern history, T.E. Lawrence once surveyed Damascus at dawn: "The silent gardens stood blurred green with river mist, in whose setting shimmered the city, beautiful as ever, like a pearl in the morning sun."

Damascus wears gracefully the many titles bestowed for her beauty – "Right Hand of Syrian Cities," "Bride of the Earth," "Queen of Cities" – and in Arabic she is called "al-Fayha," "the Fragrant," for her scent. The Emperor Julian saw Damascus as "the eye of the whole East." To al-Idrisi, writing in 1154, Damascus was "the most delightful of God's cities"; centuries later, to Lawrence, she was still "a lodestar to which the Arabs were naturally drawn."

The aura of a holy city clings to Damascus. She is one of three or four earthly paradises venerated by Arab writers, and many regard her as the loveliest. "Nothing attributed by way of description to the heavenly paradise is not found in Damascus," wrote the great geographer Yaqut in the 13th century.

The city is rich in sacred sites, with venerable links to prophets and religious figures. Abraham's steward Eliezer was a Damascene, and an ancient legend holds that Cain slew Abel in a cave atop Mt. Qasiyun. The Qur'an, in Sura XXIII, "The Believers," tells how Jesus and Mary found a lofty refuge with shelter and springs, and tradition – unsubstantiated by any historian – locates the site on a mountain top near Damascus.

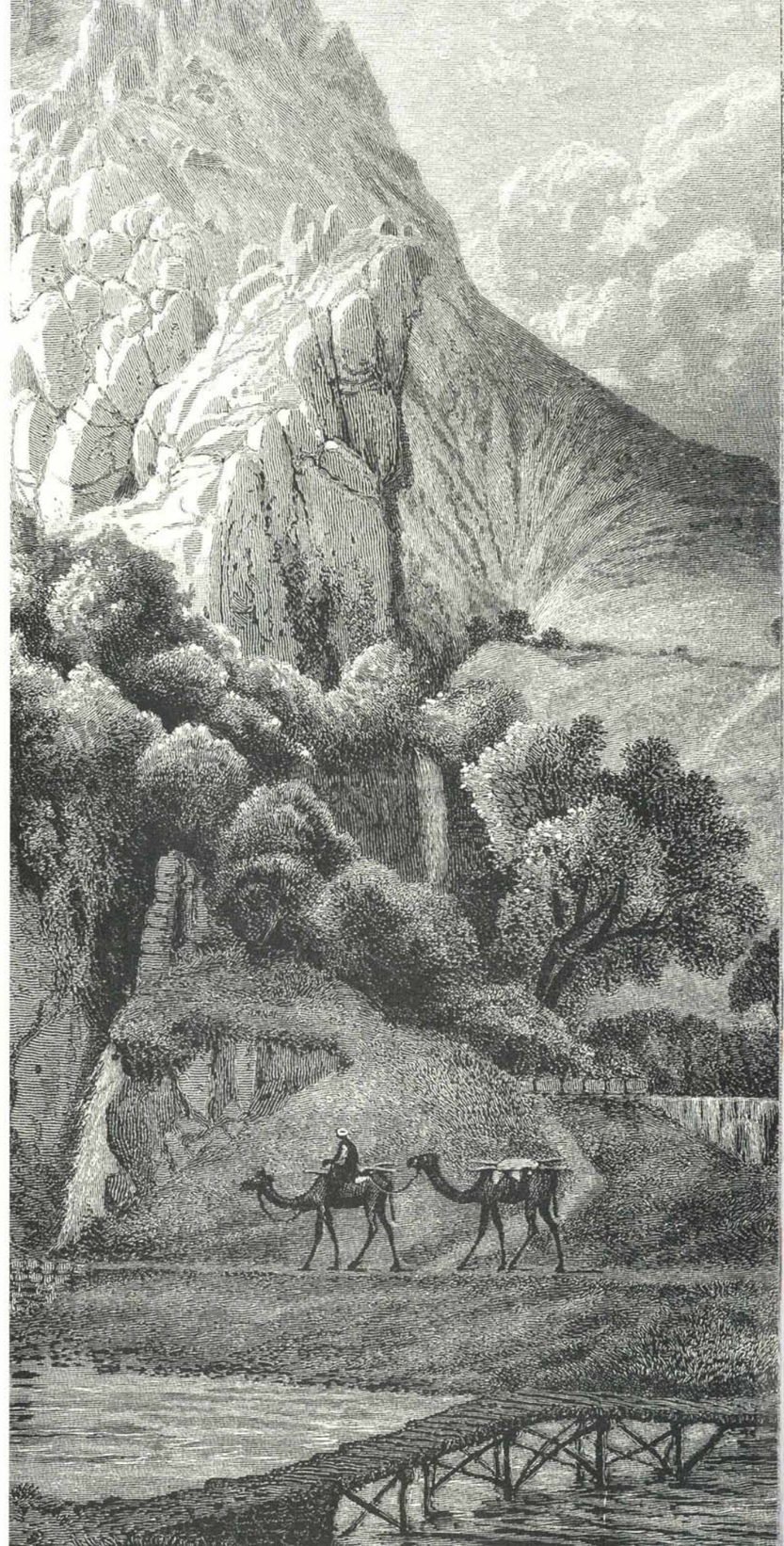
The waters of Damascus are another source of pride and legends. Even down to the beginning of this century, Damascenes held that their water could cure leprosy.

St. Paul is believed to have stayed at a house on the Street Called Straight, which still bisects the old city, and was visited by Ananias, whose chapel can be seen near the city gate Bab Tuma, or Thomas's Gate. Paul himself was later threatened, and escaped only by night, lowered in a basket through an opening in the city wall where St. Paul's Gate now stands.

Damascus also holds special significance for Muslims. The city was the capital of the Umayyad state, which ruled during an important part of Islam's greatest cultural flowering. It is one of three main gathering places, along with Baghdad and Cairo, for pilgrims to Makka. And a Damascus cemetery holds the grave of Bilal, the Prophet's muezzin (See *Aramco World*, July-August 1983).

Local folklore holds that, on Judgment Day, Jesus will descend to earth upon the eastern minaret, named for him, of Damascus's Umayyad Mosque – a belief that recently caused consternation, during renovation in the old city, among Christian merchants forced to vacate their shops near the minaret and thus relinquish proximity to the site of the Second Coming. Another local tradition, however, specifies the place of Jesus's return as the minaret at Bab al-Sharqi, the Eastern Gate.

Accounts of Damascene miracles and prophecies have been passed down through the ages, but as for detailed description of the city itself, very little exists before the ninth century of our era. Damascus became part of the Islamic empire in the year 635, and more than two centuries later, about 869, a historian named al-Baladhuri wrote the earliest surviving account of the Muslim conquests. During the siege of Damascus, he wrote, the great general Khalid ibn al-Walid camped outside Bab al-Sharqi, still today the terminus of the Street Called Straight, while at Bab Tuma to the north waited the troops of Amr ibn al-'As, the future conquerer of Egypt.



"It is extraordinarily moving, voice after voice ringing out . . . to declare the greatness of God to the people below."

Arab geographers and historians journeying across the Islamic world soon began registering a wealth of impressions about Damascus. Most accounts praise the natural beauty of the city's setting, with its bountiful water system, scented air, and lush Ghuta. One of the first Arabic geographical handbooks – written by one merchant, al-Istakhri, in 951, and edited by another, Ibn Hawkal, in 978 – describes Damascus, "the most glorious" of Syrian cities, with the wide Barada River flowing through it, "so deep that a rider cannot ford it. Below the city, again, the river waters all the villages of the Ghuta. But from above, the water is conducted into all the houses and streets and baths of the city."

Writing in Baghdad at about the same time, the geographer and traveler al-Muqaddasi also left a portrait of Damascus. Born in Jerusalem, he performed the pilgrimage to Makka at age 20, and later traversed the entire Islamic world except for Spain. In Damascus, he reported,

> prices are moderate, fruits and snow abound, and the products of both hot and cold climes are found. Nowhere else will be seen such magnificent hot baths, nor such beautiful fountains, nor people more worthy of consideration.

Unlike many other writers whose records survived, the famous geographer al-Idrisi, writing in Sicily in 1154, apparently never visited Damascus, but instead compiled his account of the Crusader-era Holy Land from books and returning travelers. He mentioned the Valley of the Violets, stretching from Damascus's western gate for 12 miles and planted with various fruit trees. He also described the city's water system, including Nahr Yazid, named after the Umayyad caliph who reconstructed the canal which still flows across the foot of Salihiya.

Damascus during the era of Saladin is described in flowery detail in the diary of Ibn Jubayr, a Spanish Arab who traveled to Egypt, Arabia, and Iraq. He arrived in Damascus from the north on the morning of July 5, 1184, and his description of the city he surveyed is often quoted:

> Its rivulets twist like serpents through every way, and the perfumed zephyrs of its flower gardens breathe life into the soul. To those who contemplate her she displays herself in bridal dress, calling to them, 'Come to the halting-place of beauty, and take midday repose.'
>
> Its ground is sickened with the superfluity of water, so that it yearns even for a drought, and the hard stones almost cry out to you, 'Strike with thy foot: here is water wherein to wash, cool and refreshing, and water to drink.' [The Qur'an, Sura XXXVIII, Verse 42]... To the east, its green Ghuta stretches as far as the eye can see, and wherever you look on its four sides its ripe fruits hold the gaze.

On the Barada's banks to the west of the city, where the Ottoman *takiyya* or pilgrim Inn now stands, lay two green *maydans* – the Sultan's polo fields, "like pieces of rolled-out silk brocade, for their greenness and beauty," with the river flowing between and poplar trees all around. Here the famous Mamluk sultan Baybars later constructed Qasr al-Ablaq, his magnificent black-and-ochre stone palace.

As more Europeans came to Damascus in the following centuries, they too left their impressions. In a famous account of a journey through Ottoman Syria – from Aleppo to Jerusalem in the spring of 1697 – Henry Maundrell told of his first, captivating glimpse of Damascus:

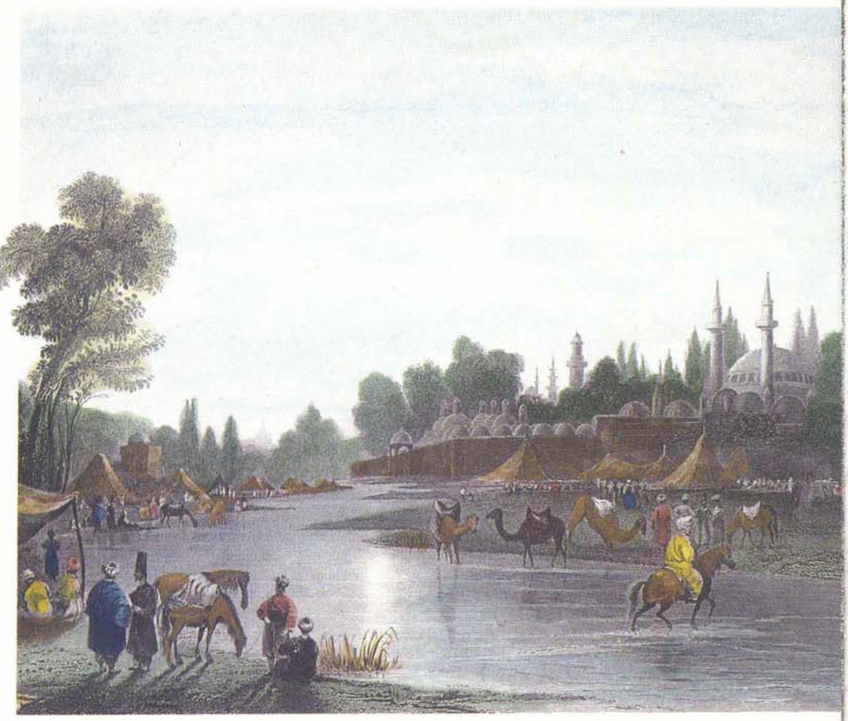
> We continued a good while upon the precipice, to take a view of the city.... It exhibits the paradise below as a most fair and delectable place, and yet will hardly suffer you to stir away, to go to it: thus at once inviting you to the city, by the pleasure which it seems to promise, and detaining you from it by the beauty of the prospect.

The domes and minarets rising above the orchards gave the Englishman the sense of a "noble city in a vast wood." While exploring the Ghuta, wrote Maundrell, "You discover ... many turrets, and steeples, and summer-houses, frequently peeping out from amongst the green boughs.... On the north side of this vast wood is a place called Solhees [Salihiya]; where are the most beautiful summer-houses and gardens."

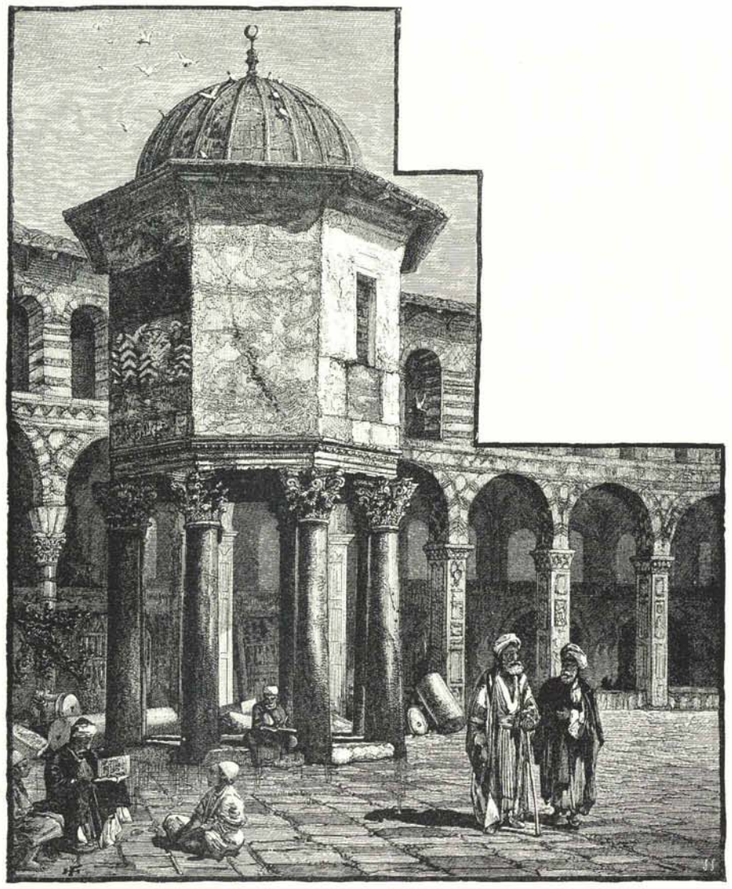
Visitors lavished long passages on the splendors of Damascus's Umayyad Mosque. In the 10th century, al-Muqaddasi praised the mosque's opulent decor:

> The Mosque of Damascus is the fairest of any that the Muslims now hold.... The whole area is paved with white marble.... Even to the very ceiling are mosaics of various colors and in gold, showing figures of trees and towns and beautiful inscriptions.... Both within the *mihrab*, and around it, are set cut-agates and turquoises of the size of the finest stones that are used in rings.... On the summit of the dome of the mosque is an orange, and above it a pomegranate, both in gold.

Al-Muqaddasi also reported that to build the mosque two centuries before, when Umayyad Damascus ruled the Islamic world, the caliph al-Walid had commissioned artisans from Persia, India, West Africa, and Byzantium, spending seven years of Syria's earnings and 18 shiploads of Cypriot gold and silver.



A ford on the Barada



"There is always a concourse of townspeople, coming to meet and converse pleasurably every evening."

In the 12th century, the mosque impressed the Spanish Arab Ibn Jubayr just as strongly, particularly the cupola over the *mihrab*, which dominated the old city's skyline then just as it does today. "From whatever quarter you approach the city," he observed, "you see this dome, high above all else, as though suspended in the air." One day at dawn, Ibn Jubayr climbed with some friends to the top of the dome – and thus was able to confirm the adage that said, "No spiders ever spin their webs in the mosque, nor do any swallows ever nest there."

The mosque courtyard at the time, during the epoch of Saladin, was a lively center of social life. "There is always a concourse of townspeople, coming to meet and converse pleasurably every evening," said Ibn Jubayr. "You may see them coming and going from east to west ...walking and talking."

About 1300, when Syria was ruled by the Mamluks of Egypt, the cosmographer Muhammad ibn Abi Talib – called al-Dimashqi, after his native city – described the mosque during the middle of the month of Sha'ban, when it was lit with 12,000 lamps. About a quarter-century later, Damascus was visited by one of history's great travelers – Shaykh Abu 'Abd Allah of Tangier, better known as Ibn Battuta (See *Aramco World*, January-February 1978). He left a record of the Umayyad Mosque's decoration prior to its burning during the conquest of Timur, or Tamerlane: The interior was embellished with gold and multi-colored mosaic, 74 stained-glass windows, and marble columns – and the mosque employed 70 muezzins.

Visitors fortunate enough to be in Damascus at the time of the Hajj, or Muslim pilgrimage, witnessed a colorful spectacle. About 1430, the French knight Bertrandon de la Brocquière recorded the return of a 3000-camel pilgrims' caravan from Makka, which traditionally arrived at the *maydan*, or open space, south of the city near the village of Qadam. The caravan included "Moors, Turks, Barbaresques, Tartars, Persians, and other sectaries of the Prophet Muhammad," while the Qur'an, wrapped in silk, was borne upon a camel covered in silk trappings, preceded by drummers, trumpeters, and musicians.

Four centuries later, the famous traveler Charles M. Doughty sketched Damascus at pilgrimage time in *Travels in Arabia Deserta*:

> There is every year a new stirring of this goodly Oriental city in the days before the Haj.... In the markets there is much taking up in haste of wares for the road. The tent-makers are most busy in their street.... The curriers in the bazaar are selling apace the water-skins and leathern buckets and saddle-bottles.... Already there come by in the streets, passing daily forth, the *akkams* [drivers] with the swagging litters mounted high upon the tall pilgrim-camels....

Damascus's rich bazaars impressed travelers with the variety of goods and the excellence of craftsmanship. Al-Dimashqi, in the early 14th century, extolled Damascus's rose water, which was exported to the Hijaz, India, and China, and concocted at the village of al-Mazza – today a modern apartment district of Damascus. Some years later, Ibn Battuta described the bazaars; one passed, he wrote, through the southern gate of the Umayyad Mosque, called Bab al-Ziyada, into a fine coppersmiths' bazaar that lined the mosque's southern outer wall. "Where the bazaar now stands was formerly the palace [called al-Khadra, or the Green Palace] of the [Umayyad] Caliph Mu'awiya, and the houses of his people," Ibn Battuta related. "The Abbasids pulled it down and transformed the place into a bazaar." On another side of the mosque, Ibn Battuta explored the bazaars of the jewelers, booksellers, glassblowers, and papermakers.

The fine damascened swords were praised about a century later by de la Brocquière; they were so highly polished that "when anyone wants to arrange his turban, he uses his sword for a looking glass. Its temper is perfect, and I have never seen swords that cut so excellently."

About 1850, under the Ottomans, a "deputation to the East" sent by the Malta Protestant College visited the bazaars, finding that

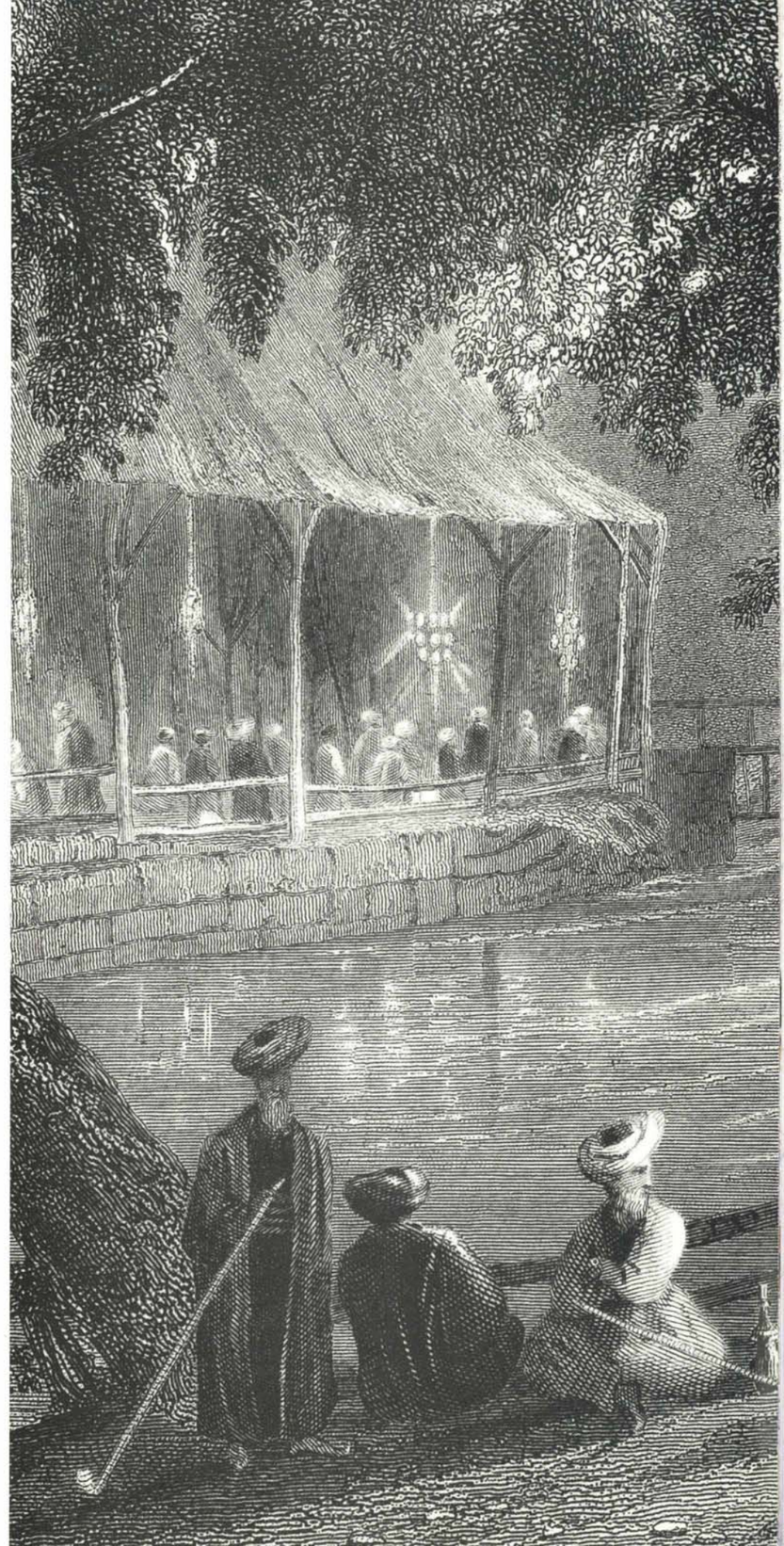
> the saddlery [located just north of the citadel] is in high repute. Damascus is also celebrated for its gold and silver tissues, and striped silk and cotton stuffs; unset precious stones, especially pearls and turquoises, are abundant; every sort of gold and silver trimming is also plentiful and cheap.

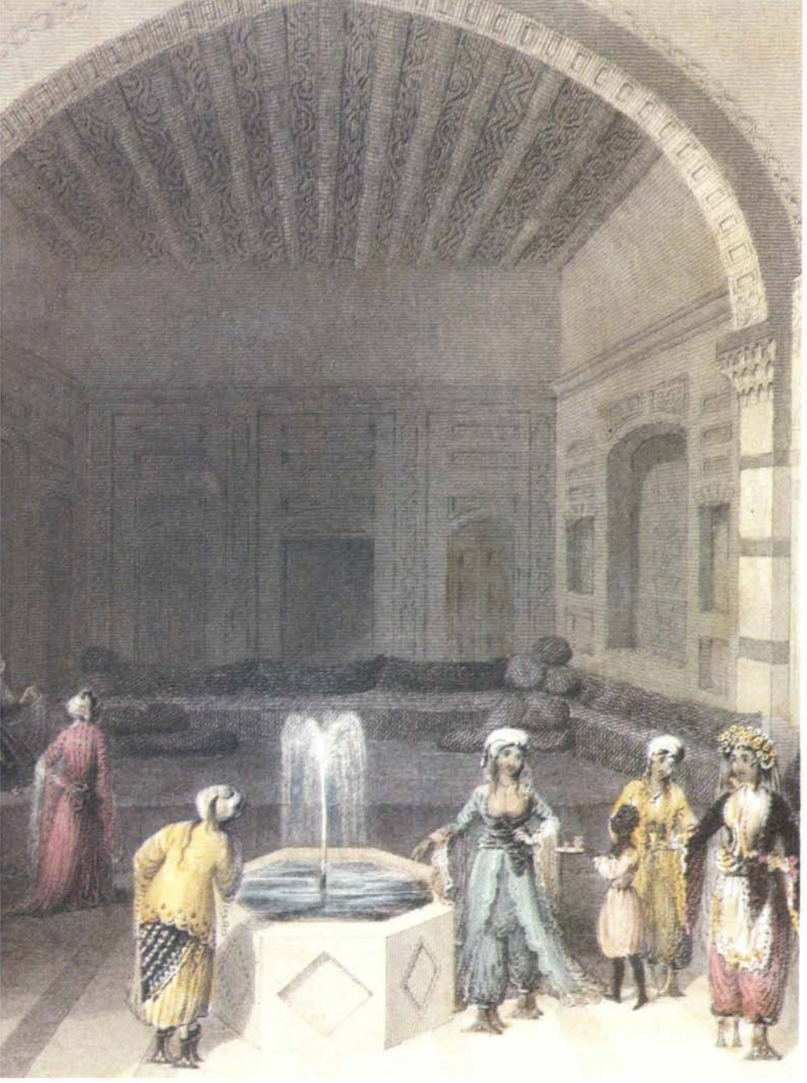
The mission also judged Assad Pasha's great khan, or inn-storehouse, to be

> the most splendid structure of the kind in the East, being built of alternate layers of black and white marble, having several tiers of large galleries, with nine domes, and the centre of the court ornamented with an immense fountain. It is used as an exchange.

In recent years, the khan, under restoration, has stood empty and open to the sky.

Many travelers have painted vivid portraits of Damascus's people, who have long held a strong sense of identity as citizens. They have also enjoyed renown for their elegance and taste for cultivated living, as expressed in their opulently appointed homes with fountains, Persian carpets, inlaid ivory and mother-of-pearl furniture, and damask silk textiles. In the 12th cen-





"We . . . found ourselves in a marble court with a fountain in the centre . . . ."

nessed the city's wild celebration as the Arab troops arrived:

> Every man, woman, and child in this city of a quarter-million souls seemed in the streets, waiting only the spark of our appearance to ignite their spirits. Damascus went mad with joy. The men tossed up their tarbushes to cheer, the women tore off their veils. Householders threw flowers, hangings, carpets, into the road before us: their wives leaned, screaming with laughter, through the lattices and splashed us with bath-dippers of scent.

The 20th century also brought two great woman travel-writers to Syria. A Friday in Damascus around 1905, wrote Gertrude Bell, was

> a sight worth traveling far to see. All the male population dressed in their best parade the streets, the sweetmeat sellers and the auctioneers of second-hand clothes drive a roaring trade, the eating shops steam with dressed meats of the most tempting kind, and splendidly caparisoned mares are galloped along the road by the river. . . .

She was also invited into the graceful atmosphere of a great Damascus house:

> We entered through a small door in a narrow winding street by a dark passage, turned a couple of corners and found ourselves in a marble court with a fountain in the centre and orange trees planted round. All the big rooms opened into this court . . . and coffee and sweetmeats were served by the groom of the chambers, while I admired the decoration of the walls and the water that bubbled up into marble basins and flowed away by marble conduits. In this and in most of the Damascene palaces every window sill has a gurgling pool in it, so that the air that blows into the room may bring with it a damp freshness.

Freya Stark, who followed in 1928, lived in Damascus's old city for some time, and her *Letters from Syria* chart a rising enchantment with the city. From her house's flat roof, she watched cloud shadows sweeping over the city's domes and hills; "The light is lovely, so pure and brilliant. . . . There is nothing on these naked hills to interfere with its lovely play, and they change like water with the reflections of the sky." When sunset heralded the end of Ramadan, the Muslim fasting month, she observed,

> Such a business in the bazaars, shopping for the feast. It lasts three days. We went on to the roof to hear the muezzin: it is extraordinarily moving, voice after voice ringing out from the high steeples to declare the greatness of God to the people below.

Even present-day Damascus, with industries sprawling outward into the Ghuta and apartment blocks creeping up the slopes of Mt. Qasiyun, continues to captivate travelers. The most engaging modern eulogy to the city – an account of life in the old town interwoven with history – is *Mirror to Damascus*, written in 1967 by the English poet and novelist Colin Thubron. The *savoir-vivre* of Damascenes, in his eyes, dates back to the glorious era of the Umayyads:

> The grace of the Damascenes is still spoken of, their love of fine clothes and food, their passion for music. It is probably absurd to ascribe this spirit to the pleasure-loving eighth-century caliphs, yet if they returned to the East tomorrow, I believe that Damascus would be the city of their choice still.

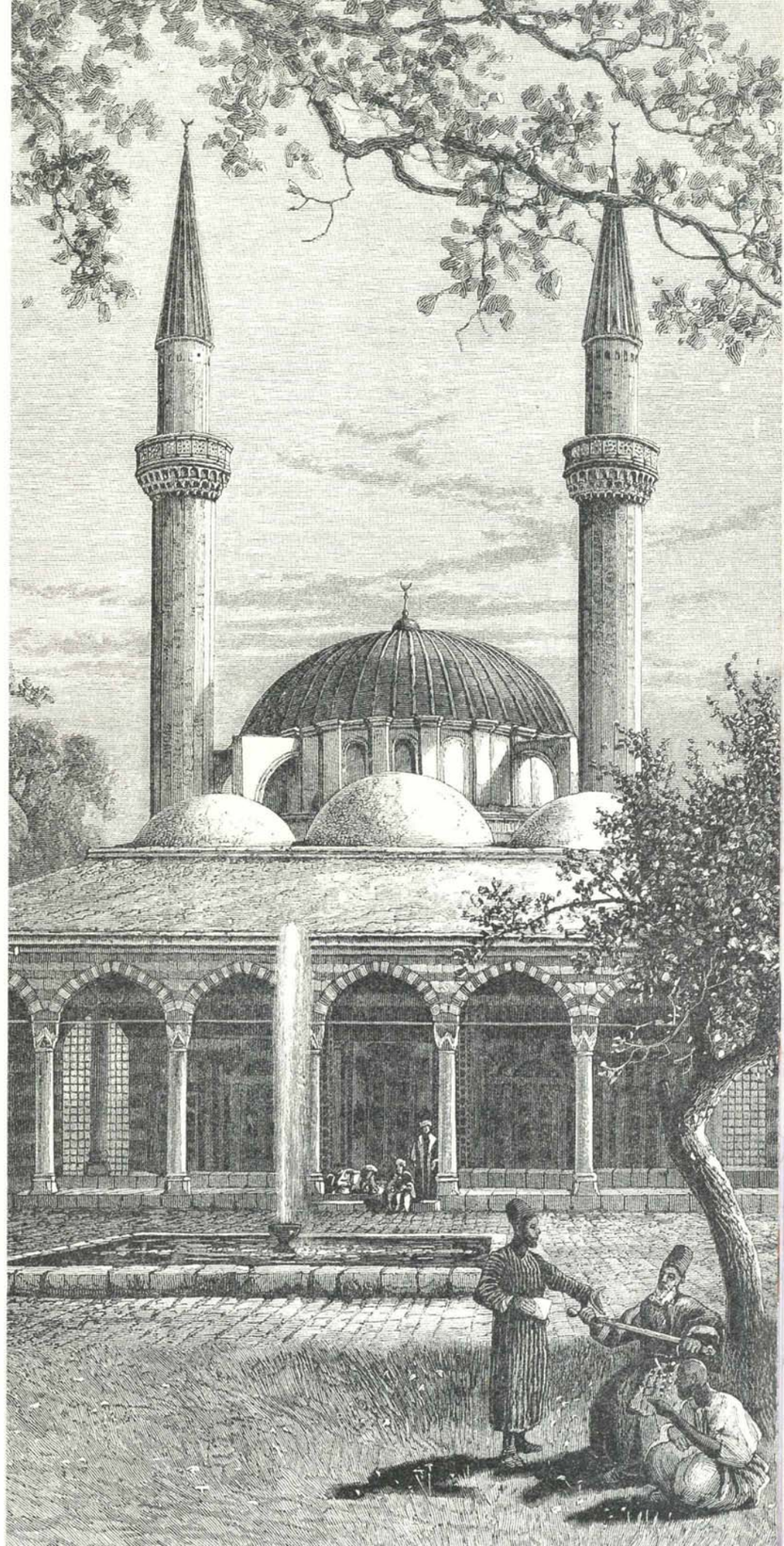
Palpably haunted by kings and past glories, even 20th-century Damascus inspires travelers to visions, as when Thubron saw an apparition – the caliph Yazid of Umayyad times:

> Some cities oust or smother their past. Damascus lives in hers. Her marble courtyards stir the mind to strange fancies, glimpsed the end of a joyous procession: [Yazid] had passed by in his silken hunting dress, cheetah at pommel, hawk on wrist. . . .

In a breath of jasmine, a splash of rose water, the play of a fountain – or the lilting rise of the Damascene drawl – the many-splendored city continues to enchant.

Lynn Teo Simarski, a writer and editor specializing in the Middle East, lived in Syria for two years.

Mosque of the *takiyya* of Sultan Selim



SUGGESTIONS FOR READING

□ CURRENT EVENTS IN THE MIDDLE EAST – AND INDEED THE GROWING INFLUENCE OF THE ARAB AND MUSLIM WORLDS, IN THE LAST 20 YEARS, ON EVENTS BEYOND THEIR BORDERS – HAVE AROUSED MUCH INTEREST AMONG OLD AND NEW READERS OF *ARAMCO WORLD* IN LEARNING THE BACKGROUND OF THESE EVENTS □ BELOW, WE SUGGEST SOME READINGS THAT WILL CONTRIBUTE TO GREATER UNDERSTANDING □

Amina and Muhammad's Special Visitor. *Diane Turnage Burgoyne. Penny Williams-Yaqub, illustrator. Rockport: A & M Book Sales, 1982.* A beautifully illustrated book about two children and their family in modern Saudi Arabia. Text is for primary-school children, notes are for parents or teachers. The book seeks to dispel the impression that most children in Arabia live the life of the traditional Bedouins.

The Arab Awakening: The Story of the Arab National Movement. *George Antonius. Troy: International Book Center, 1969, 0-86685-000-7.* The classic account of the birth and development of Arab nationalism, from its origins in Syria in 1847 to its collision with Zionism in the 1930's. Also contains text of crucial documents of the period, including the Sikes-Picot Agreement and the King-Crane Report.

Arab Folktales. *Inea Bushnaq, translator and editor. New York: Pantheon Books, 1986, 0-394-50104-7 (hb), 0-394-75179-5 (pb).* A good way to penetrate a culture is through its folktales. This is a wonderful collection of popular stories from all parts of the Arab world.

The Arab World: Personal Encounters. *Elizabeth Warnock Fernea and Robert A. Fernea. New York: Doubleday, 1987, 0-385-23973-4.* A sensitive and colorful portrait of the Arab world – from oil and politics to the realities of daily life – by a celebrated academic couple whose experience in the region dates back to 1956.

Arabia of the Wahhabis. *H. St. John B. Philby. Salem: Ayer, [n.d.], 0-405-05355-X; London: Cass, 1977, 0-7146-3073-X.* One of the British explorer's classic works on Arabia. A new impression of the 1928 edition, with additions.

Arabia Unified: A Portrait of Ibn Saud. *Mohammed A. Almana. New Brunswick: North American, 1985, 0-930244-05-2 (hb), 0-930244-06-0 (pb); London: Hutchinson Benham, 1980, 0-09-141610-8.* A fascinating insider's view of the unification of Arabia under King 'Abd al-'Aziz Al Saud. Almana was court translator from 1926 to 1935, and a constant companion of the king on all his travels and expeditions.

Arabs in the New World: *Studies on Arab-American Communities. Sameer Y. Abraham and Nabeel Abraham, editors. Detroit: Wayne State University, 1983, 0-94356-000-4.* This book offers much-needed insight into an important aspect of US-Arab interaction, the three-million-strong Arab-American community.

Aramco and Its World: Arabia and the Middle East. *Arabian American Oil Company. Edited by Ismail I. Nawwab, Peter C. Speers and Paul F. Hoye; main research and writing by Paul Lunde and John A. Sabini. Dhahran: Aramco, 1981, 0-9601164-2-7.* A comprehensive illustrated reference on Saudi Arabia and its place in the modern world, with chapters on the pre-Islamic period, Islam and Islamic history, Saudi Arabia today, and oil and Aramco. The book explores the history and contributions of Arabia and the Middle East, and includes a useful bibliography.

Atlas of the Islamic World Since 1500. *Francis Robinson. New York: Facts on File, 1982, 0-87196-629-8; Oxford: Phaedon Press Ltd., 1982, 0-7148-2200-0.* A beautifully illustrated work on the transmission of Islamic culture from generation to generation and from state to state over the past five centuries.

Birds of the Eastern Province of Saudia Arabia. *G. Bundy, R. J. Connor and C. J. O. Harrison. London: Witherby, 1989, 0-85493-180-5.* Besides a systematic list heavily illustrated with excellent photographs, the book includes an ecological overview of land, climate and vegetation and articles on the origins and types of birds; migration, adaptation and habitat; and human influence.

Concise Encyclopedia of Islam. *Cyril Glassé. New York: Harper & Row, 1989, 0-06-063123-6.* The first major reference work on all aspects of Islamic culture, religion, history and law – nearly 1200 entries – written for Western readers by a practicing Muslim.

Covering Islam: How the Media and the Experts Determine How We See the Rest of the World. *Edward W. Said. New York: Pantheon, 1981, 0-394-51319-3; London: Routledge & Kegan Paul, 1981, 0-7100-0840-6.* An eloquent spokesman for the Arabs writes about Western, and especially American, responses to the Muslim and Arab worlds since the early 1970's.

The Cultural Atlas of Islam. *Isma'il R. al Faruqi and Lois Lamya' al Faruqi. New York and London: Macmillan, 1986, 0-02-910190-5.* A marvelous, comprehensive work that explains Islam – its beliefs, institutions, traditions and influences – in the context of the cultures in which the faith has taken root.

Europe and the Middle East. *Albert H. Hourani. Berkeley: University of California Press, 1980, 0-520-03742-1; London: Macmillan, 1980, 0-333-26948-9.* Eight essays on Western understanding of Islam. Hourani is much more positive than Edward Said, in *Orientalism*, about Western views of the Islamic world.

The Genius of Arab Civilization: Source of Renaissance. *Second Edition. John R. Hayes, editor. Cambridge [Mass.]: MIT Press, 1983, 0-262-08136-9 (hb), 0-262-58063-2 (pb); London: Kegan Paul International, 1983, 0-7103-0083-2 (pb).* Funded by Mobil Oil Corporation, this richly illustrated book introduces readers to the cultural, artistic and scientific achievements of the Arabs, with chapters written by scholars in various fields. The second edition contains an added chapter on Arab music as well as updated sections.

God is One: The Way of Islam. *R. Marston Speight. New York: Friendship Press, 1989, 0-377-00196-1.* Written by a Christian who spent years living among Muslims, this book assumes no prior knowledge. It presents an open-minded and straightforward, if necessarily simple, explanation of Islamic life and culture.

Guests of the Sheik: An Ethnography of an Iraqi Village. *Elizabeth Warnock Fernea. New York: Doubleday, 1969, 0-385-01485-6.* A classic account of life in a village in southern Iraq, from the viewpoint of an American woman who adopts the *'abaya* and other local customs in an effort to get to know the people of her community.

A History of the Arab Peoples. *Albert Habib Hourani. Cambridge [Mass.]: Harvard University Press, 1991, 0-674-39565-4; London: Faber, 1991, 0-571-13378-9.* A new and worthwhile history of the Arabs from the rise of Islam to the present day, by an eminent authority. The book highlights the cultural unity of the Arabs over the centuries. A History Book Club main selection in the United States.

History of the Arabs From the Earliest Times to the Present. *10th edition. Philip K. Hitti. Boston: St. Martin, 1970, 0-312-37520-4.* This book, by the founder of Middle Eastern studies in the United States, remains the classic text though its first edition was published in 1937.

Ideals and Realities of Islam. *Seyyed Hossein Nasr. Boston: Beacon Press, 1972, 0-8070-1131-2; London: Allen & Unwin, 1985. 0-04-297049-0.* A lucid presentation of some important aspects of Islamic religion and culture and their relation to present-day society.

Introduction to Islam. *Muhammad Hamidullah. Paris: Centre Culturel Islamique, 1969, 2-901049-02-8 (hb); 1980, 2-901049-05-2 (pb).* A simple introduction to Islamic beliefs, practices and history.

Islam: Its Meaning and Message. *Kurshid Ahmad, editor. Ann Arbor: New Era, 1976, 0-86037-000-3; Leicester: The Islamic Foundation, 1980, 0-86037-002-X (hb), 0-86037-000-3 (pb).* A collection of essays by prominent Muslim scholars on Islam as a way of life.

Islam: The Straight Path. *Expanded Edition. John L. Esposito. New York and Oxford: Oxford University Press, 1991, 0-19-506225-6.* A useful and highly regarded introduction to Islamic faith, history, culture and politics, updated to reflect important new developments in the Islamic world.

Islamic Science: An Illustrated Study. *Seyyed Hossein Nasr. London: World of Islam Festival, 1976, 0-905035-02-X.* The first illustrated study of the whole of Islamic science ever published. Areas covered include alchemy, medicine, pharmacology, astronomy, mathematics, natural history and physics.

Islamic Technology: An Illustrated History. *Ahmad Y. al-Hassan and Donald R. Hill. New York and Cambridge [UK]: Cambridge University Press, 1987, 0-521-26333-6.* The first detailed account of the ingenious and sophisticated technologies that sprang from the scientific achievements of Islam's golden age. Lavishly illustrated.

The Legend of Islam. *Joseph Schacht and C.E. Bosworth, editors. Oxford: Oxford University Press, 1979, 0-19-82191-3.* A comprehensive look at the Islamic world's contributions to science, literature, philosophy, the arts and other endeavors.

Looking for Dilmun. *Geoffrey Bibby. New York: Alfred A. Knopf, 1969, 0-394-43400-5; London: Penguin, 1984, 0-14-009534-9.* Englishman Bibby, field director of a Danish archeological expedition in Bahrain, recounts his discovery of proof of the existence of Dilmun, a legendary high trading civilization that preceded ancient Sumer, and whose territory included parts of today's Eastern Province of Saudi Arabia.

The Mantle of the Prophet: Learning and Power in Modern Iran. *Roy Mottahedeh. New York: Pantheon, 1986, 0-394-74865-4; London: Chatto & Windus, 1986, 0-7011-3035-0.* Equal parts fiction, autobiography and text, this book describes the making of a modern ayatollah, from childhood in Qom through education in a Shi'a seminary to adult life in revolutionary Iran. In the process, Mottahedeh paints a vivid picture of Iranian life and its rich and ancient traditions.

The Meaning of the Glorious Koran. *Mohammed Marmaduke Pickthall, translator. New York: Hippocrene Books, 1988, 0-88029-209-1 (hb), NAL-Dutton, 1953, 0-451-62745-8 (pb).* A skilled effort to present the meaning of the Qur'an, as well as something of its magnificence, in English.

The Middle East: Ten Years after Camp David. *William B. Quandt, editor. Washington, D.C.: The Brookings Institution, 1988, 0-8157-7293-9.* Scholars and former officials involved in the Middle East peace process assess prospects for progress on the 10th anniversary of the Camp David accords. Writers include Hermann Eilts, Rashid Khalidi, Samuel Lewis, Evgeni Primakov and Harold Saunders.

Middle East Patterns: Places, Peoples, and Politics. *Colbert C. Held. Boulder: Westview Press, 1989, 0-8133-0016-9 (hb), 0-8133-0017-7 (pb).* Written by a retired US Foreign Service officer. A fine mid-level text for courses in Middle Eastern geography, this book is also a valuable reference for anyone interested in the history, politics, comparative government and economics of the region.

Middle Eastern Women Speak. *Elizabeth Warnock Fernea and Basima Qattan Bezirgan, editors. Austin: University of Texas Press, 1977, 0-292-75033-1.* Autobiographical and biographical writings by and about Middle Eastern women, from the beginning of Islam to the present, show what women from a wide range of classes and occupations think and feel.

Muhammad: His Life Based on the Earliest Sources. *Martin Lings. London: Allen & Unwin, 1983, 0-04-297042-3; 1986, 0-04-297050-4 (pb).* A well-narrated biography of the Prophet of Islam by a British Muslim scholar, based on traditional sources.

A Peace to End All Peace: Creating the Modern Middle East 1914-1922. *David Fromkin. New York: Holt, 1989, 0-8050-0857-8.* A fresh, detailed and enlightening look at how and why the Allies came to remake the geography and politics of the Middle East from 1914 onward. Based in part on Fromkin's research in recently opened archives.

A New Book of Middle Eastern Food. *New and enlarged edition. Claudia Roden. London: Penguin, 1985; New York: Viking Penguin, 1985, 0-670-80144-5.* As much a cultural experience as a cookbook, this work blends treasured family recipes and countless classic dishes of the region with a steady flow of stories, myths and rituals from all parts of the Middle East. The recipes, using US and metric measurements, work.

Nomads of the Nomads: The Al Murrah Bedouin of the Empty Quarter. *Donald Powell Cole. Arlington Heights: Harlan Davidson, 1975, 0-88295-605-1.* Cole, an anthropologist, was the first of his profession to conduct field work in modern Saudi Arabia. An "ethnographic explorer," he spent 18 months in the late 1960's living with the Al Murrah, one of the most traditional tribes in the kingdom.

The Ottoman Centuries: The Rise and Fall of the Turkish Empire. *Lord Kinross. New York: Morrow, 1977, 0-688-03093-9.* The Ottoman Turks held sway over much of the Middle East for six centuries. This is a richly detailed and readable history of that period by the author of *Ataturk*.

The Principles of State and Government in Islam. *Muhammad Asad. Berkeley: University of California Press, 1962; Gibraltar: Shorouk International, 1985, 1-85024-010-8.* A brief, seminal work by a leading scholar explaining the theoretical basis of modern Islamic political thinking.

The Prize: The Epic Quest for Oil, Money and Power. *Daniel Yergin. New York: Simon & Schuster, 1991, 0-671-50248-4.* Widely acclaimed as the definitive history of the oil industry, this best-seller is written in an appealing narrative style and focuses on the personalities who have built the industry.

The Quranic Art of Calligraphy and Illumination. *Martin Lings. New York: Interlink Books, 1976; London: World of Islam Festival Trust, 1976, 0-940793-00-8.* A stunning coffee-table book displaying some of the finest examples of Arabic calligraphy and colorful illuminated pages from Qur'ans of the world's great museums and libraries.

The Road to Mecca. *Muhammad Asad. Ann Arbor: New Era, 1981. 0-317-52460-7; London: Fugard Athol, 1985, 0-571-13691-5 (pb); Gibraltar, Shorouk International, 1981, 1-85024-008-6 (hb).* A fascinating, readable autobiography of one sophisticated Westerner's spiritual journey from Judaism into Islam.

Seven Pillars of Wisdom. *T.E. Lawrence. London and New York: Viking Penguin, 1976, 0-14-001696-1.* The Arab Revolt of World War I, from the perspective of an Englishman who took part in it. Some aspects of his account are disputed.

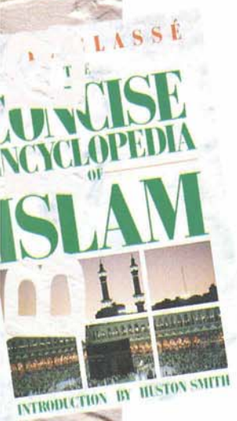
Speak, Bird, Speak Again: Palestinian Arab Folktales. *Ibrahim Muhawi and Sharif Kanaana. Berkeley: University of California Press, 1988, 0-520-05863-1 (hb), 0-520-06292-2 (pb).* A collection of charming – and often pungent – folktales with detailed glosses that shed light on aspects of popular Arab culture.

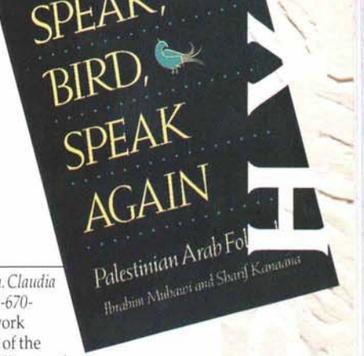
Towards Understanding Islam. *Abul A'la Maududi. Chicago: Kazi Publicatons, n.d., 0-686-18479-3; Leicester: Islamic Foundation, 1980, 0-86037-065-8.* A concise explanation of the main teachings of Islam by one of the greatest of modern Muslim thinkers.

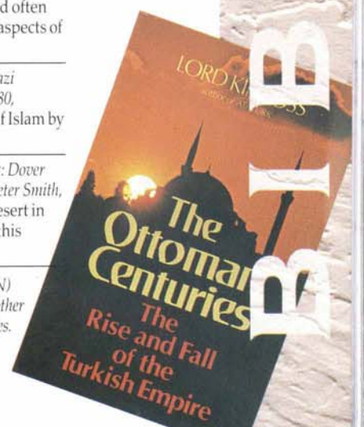
Travels in Arabia Deserta. *2 vols. Charles M. Doughty. New York: Dover Books, 1979. Single volume edited by Edward Garnett. Magnolia: Peter Smith, 1981, 0-8446-1159-X.* A classic account of life in the Arabian desert in the late 1870's, written in elegant, semi-archaic language by this celebrated traveler, geologist and itinerant scholar.

Ten-digit numbers are International Standard Book Numbers (ISBN) provided for ease in identifying and ordering books. In some cases, other editions than those listed may be available in book-stores and libraries.

COMPILED BY ROBERT W. LEBLING, JR.

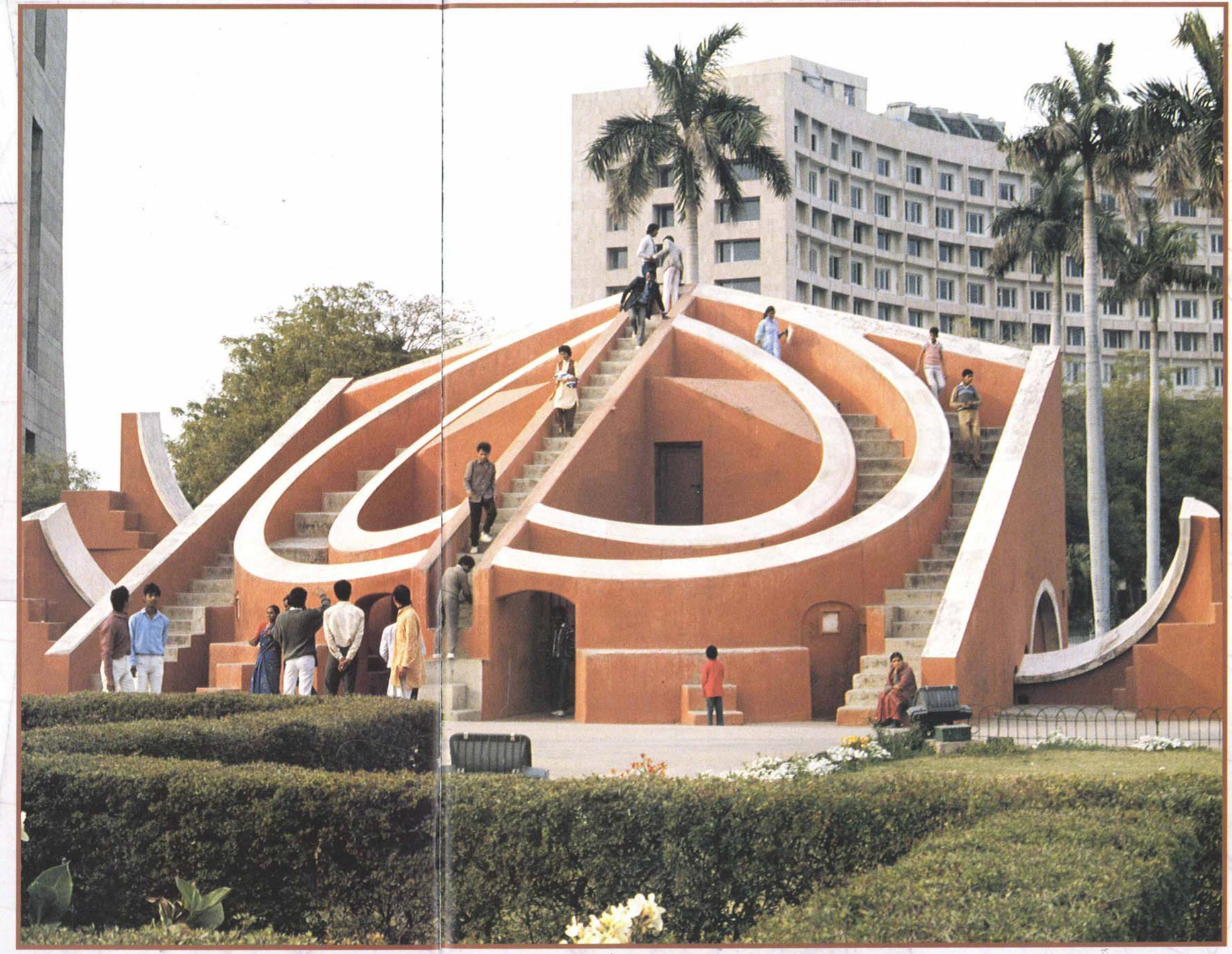






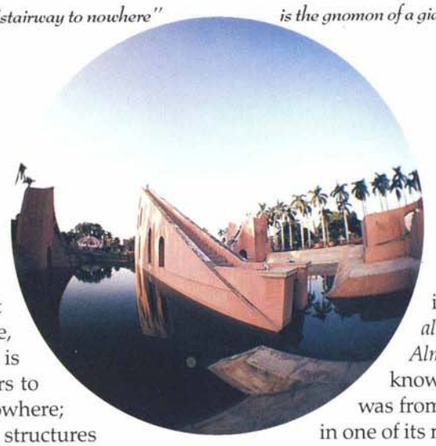
WRITTEN BY PAUL LUNDE
PHOTOGRAPHED BY PAUL LUNDE AND LESTER BROOKS

Jai Singh AND THE Jantar Mantar



The Misra Yantra, or "mixed instrument," in Delhi.

Jai Singh's "stairway to nowhere" is the gnomon of a giant sundial.



In New Delhi, just behind the famous Imperial Hotel, is a quiet and beautifully kept garden which contains six large, strange masonry structures. It is dominated by what appears to be a steep staircase to nowhere; even stranger are two cylindrical structures with central pillars and radial marble spokes. The visitor might be forgiven for thinking he had strayed into an exhibition of avant-garde sculpture, although these futuristic shapes have a solidity and a clean, functional beauty foreign to most contemporary art.

This a *jantar mantar*, or astronomical observatory. The structures are gigantic instruments for calculating the positions of heavenly bodies. It was built in 1724 by Jai Singh, Maharaja of Jaipur, at the request of the Moghul emperor Muhammad Shah.

Jai Singh was born in 1688, a year after the publication of Newton's *Principia*, and in 1700, when he was 11 years old, he succeeded his father as ruler of the small Rajasthani state of Amber. By the time of his death, he had increased his domains until they included most of what is now the modern province of Rajasthan. Although of course Hindu, he ruled as deputy for a number of Moghul emperors, the most important of whom was Muhammad Shah, who came to the throne in 1719.

Very little is known of Jai Singh's early years, of when or how he developed an interest in mathematics and astronomy. It is said that at the age of 13 he invented an ingenious method of raising water to irrigate the hanging gardens of Amber, the extraordinary fortress-palace in the mountains overlooking Jaipur.

Jai Singh was an accomplished scholar of both Sanskrit and Persian at an early age, and thus had direct access to both the Indian and the Islamic scientific traditions. He sponsored a number of translations into Sanskrit of Arabic astronomical and mathematical works, and his library, the Pothi Khana in the beautiful City Palace of Jaipur, still contains 18 manuscripts of Islamic scientific works.

It is fascinating that Jai Singh's assistant, Samrat Jagannath, was commissioned to translate the fundamental work of Greek astronomy, Ptolemy's *Mathematike Syntaxis*, into Sanskrit some 1500 years after the death of the author. Ptolemy lived in the middle of the second century of our era, and the *Mathematike Syntaxis* had been translated into Arabic in 827, under the name *al-Majisti*, or *The Greatest* – whence *Almagest*, the name the work was known by in the Latin Middle Ages. It was from the Arabic translation, probably in one of its revised forms, that Jagannath prepared the Sanskrit version.

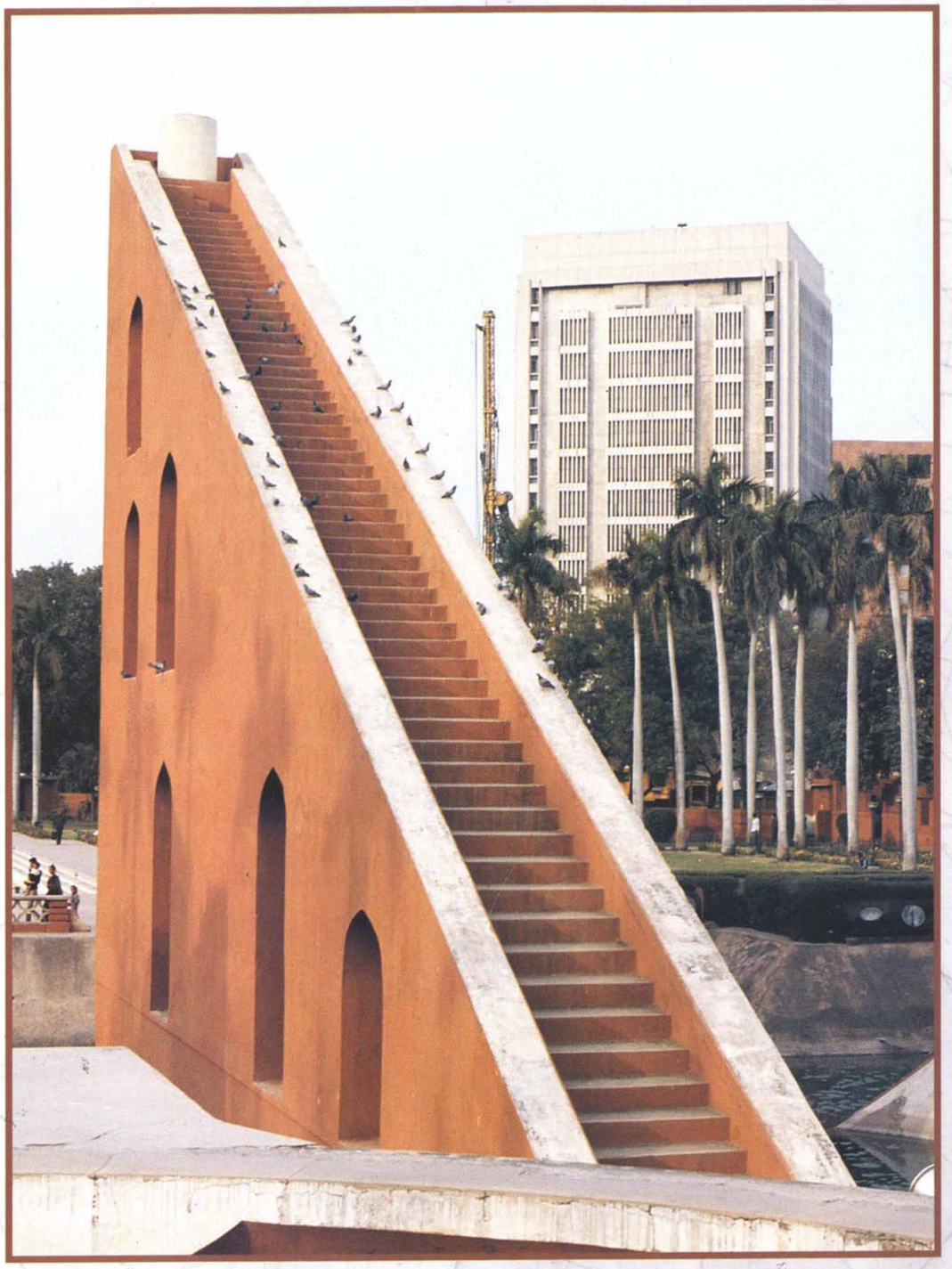
Ptolemy's *Almagest* is perhaps the longest-lived and most influential textbook ever written. For almost a millennium and a half it dominated scholars' minds, and it was not until the 16th and 17th centuries that men like Tycho Brahe, Copernicus, Galileo and Sir Isaac Newton finally demolished the Ptolemaic view of the universe.

For the *Almagest* contained a fundamental error: Ptolemy believed that the earth was stationary and that the sun revolved around it. In order to make observation fit this mistaken model, Ptolemy had to resort to ingenious and complicated calculations. It is a tribute to his inventiveness that the result provided a perfectly adequate explanation of observed planetary movement – even though the basic premise was entirely mistaken.

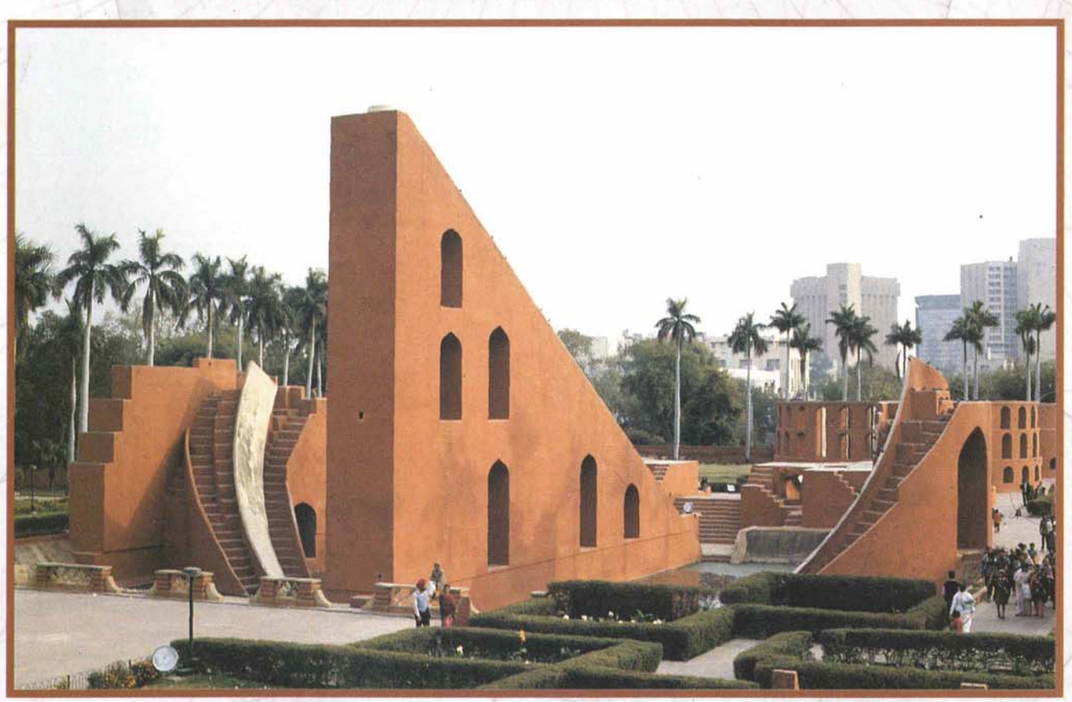
The great Arab and Persian astronomers of the Middle Ages never seriously questioned the Ptolemaic model of the universe. Their efforts were concentrated on refining details of the system, elaborating Ptolemy's brilliant exposition of trigonometry and, particularly, in the design and fabrication of new and increasingly sensitive observational instruments.

It was this tradition of practical astronomy that interested Jai Singh. Books VII and VIII of the *Almagest*'s 12 contain a list of the fixed stars of the northern and southern hemispheres, arranged by constellation. The latitude, longitude and magnitude, or apparent brightness, of each star is given. Altogether, Ptolemy catalogued 1022 stars – all, of course, visible with the naked eye, for the telescope lay some 1500 years in the future.

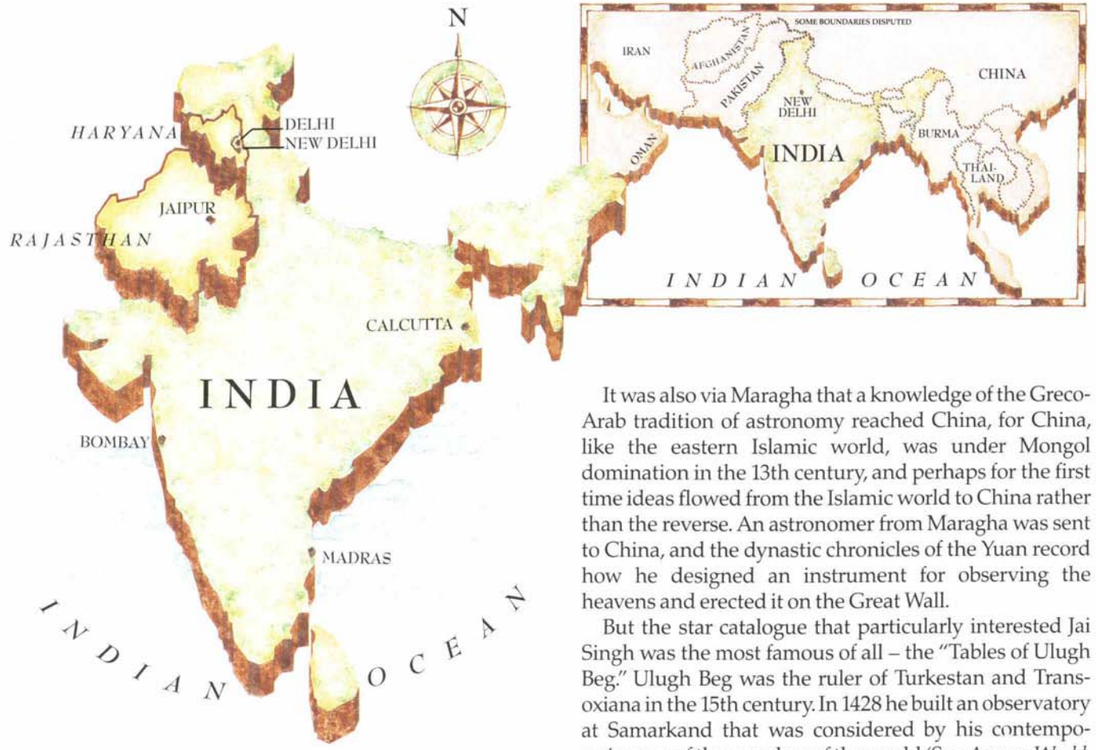
At various times, Islamic scholars sought to bring Ptolemy's star catalogue up to date, as well as to fix the positions of the stars more accurately as they refined new astronomical instruments. This was first done by the scholars of Gondeshapur, not far from Baghdad, in AD 800. An observatory was founded in Baghdad itself in 819 – perhaps the first true observatory since Alexandria – and a new star catalogue prepared. In the year 1000, a



Graduated walls and floor of the Ram Yantra show altitude and azimuth of sun, stars and planets.



Shadow of Samrat Yantra's gnomon falls on one of two curved, graduated planes rising on either side.



star catalogue was prepared at the observatory in Cairo for the Fatimid caliph al-Hakim, and in 1118 an astronomer named al-Khazini prepared another at the observatory of Nishapur, in today's Iran, which had been founded in 1074.

Similar efforts were made in Islamic Spain, where in 1080 the "Toledan Tables" were produced, to be followed in 1252 by the "Alfonsine Tables," prepared in Seville for Alfonso the Wise by Arab astronomers.

Seven years after the compilation of the Alfonsine Tables, far away to the east, in a small town in Azerbaijan called Maragha, a new and important star catalogue was prepared. Maragha was the preferred residence of Hulagu Khan, the grandson of Genghis, who in 1258 had sacked Baghdad and put an end to the Abbasid caliphate. Here Hulagu – who, perhaps surprisingly, was very interested in science – established an important observatory and placed it under the directorship of one of the leading scientists of the time, Nasir al-Din al-Tusi. His "Il-Khanid Tables," as they are called, were the most accurate so far produced. The instruments used at the Maragha observatory were described in detail by a Syrian instrument maker named Mu'ayyad al-Din al-'Urdi, so we know more about Maragha than any other observatory in the Islamic world.

It was also via Maragha that a knowledge of the Greco-Arab tradition of astronomy reached China, for China, like the eastern Islamic world, was under Mongol domination in the 13th century, and perhaps for the first time ideas flowed from the Islamic world to China rather than the reverse. An astronomer from Maragha was sent to China, and the dynastic chronicles of the Yuan record how he designed an instrument for observing the heavens and erected it on the Great Wall.

But the star catalogue that particularly interested Jai Singh was the most famous of all – the "Tables of Ulugh Beg." Ulugh Beg was the ruler of Turkestan and Transoxiana in the 15th century. In 1428 he built an observatory at Samarkand that was considered by his contemporaries one of the wonders of the world (See *Aramco World*, January-February 1990). The catalogue of 1018 fixed stars prepared under Ulugh Beg's auspices was the most accurate and detailed yet produced, and Jai Singh decided to bring it up to date, for in the 297 *hijri* years that separated the two rulers the observed position of the "fixed" stars had changed.

At first Jai Singh experimented with the small brass instruments normally used by Islamic astronomers, but he decided that their size was in itself a source of observational error. In the preface to his tables, which he named *Zij Muhammad Shahi*, in honor of his patron, he explains:

> *To carry out the order he had received...he constructed several of the instruments of an observatory like that of Samarkand, according to the books of the Muslims, such as a brass armillary sphere two meters [6.5 feet] in diameter, a two-ringed astrolabe [and others].... But he found that these brass instruments were not sufficiently accurate, because of their small size, the lack of division into minutes, the wearing of their axes, the displacement of their centers and the shifting of the planes of the instruments. He concluded that the observations of the ancients, men like Hipparchus and Ptolemy, were inaccurate because of this.*

One of two complementary hemispheres of the Jai Prakas Yantra in Jaipur.

Some of the brass instruments used by Jai Singh still survive and are on display in the City Palace Museum in Jaipur and in the museum at Kotah. To counteract the errors which he believed to be the result of using relatively small instruments, Jai Singh decided to build very large stationary instruments in stone, with the graduations cut into the marble or limestone. These are the instruments that can still be seen at the jantar mantar in Delhi.

Jai Singh was not the first astronomer to attribute observational error to the small size of his instruments. The famous 11th-century historian and astronomer al-Biruni said, "It is impossible to fix the parts of the greatest circle by means of the smallest circle. I refer to the smallness of the instruments of observation in comparison with the vastness of the bodies which are to be observed." And another Muslim astronomer wrote, "The larger the instrument, the more correct the observation."

Jai Singh claims to have invented three of the most imposing instruments in the jantar mantar himself, and this may well be true. It is also possible, however, that he had descriptions of similar instruments used in Ulugh Beg's observatory. Still speaking of himself in the third person, Singh says:

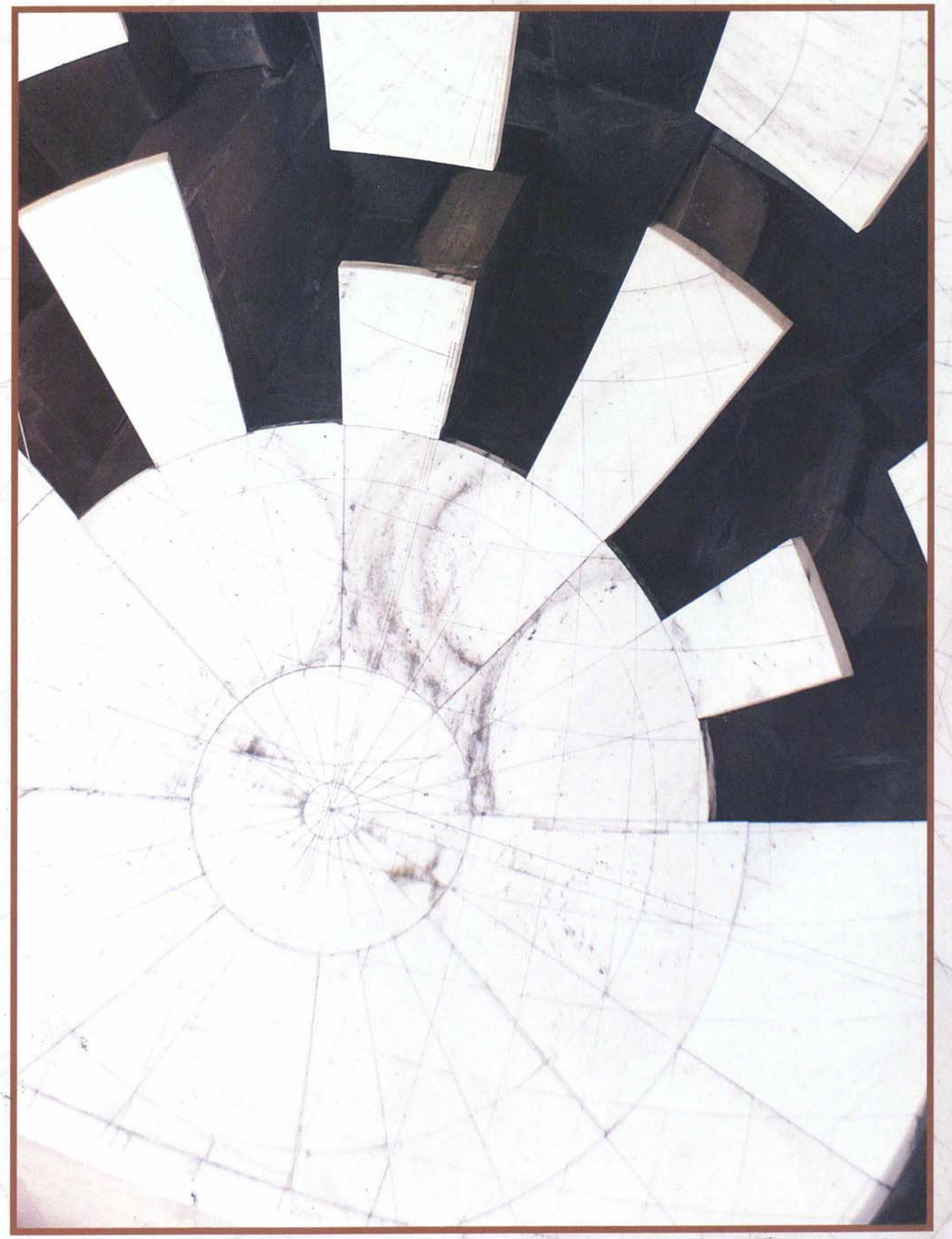
> *Therefore he built [in Delhi]...instruments he invented himself, such as the Jai Prakas, Ram Yantra and Samrat Yantra...with attention to the rules of geometry and taking care to adjust to the meridian and to the latitude of the place, and taking care in measuring and siting them so that inaccuracies from the shaking of the circles and wearing of the axes and displacement of their centers and the inequality in the marking of the minutes might be eliminated. Thus an accurate method of constructing an observatory was established and the difference between the calculated and observed positions of the fixed stars and planets through observation of their mean motions was eliminated.*

The Samrat Yantra (Prince of Instruments) is the most immediately striking structure in the observatory, the staircase that seems to lead nowhere. In fact, it is nothing more than a gigantic equinoctial dial, or sundial. It consists of a stone gnomon, as the pointer of a sundial is called, whose hypotenuse is parallel to the earth's axis. On either side is a quadrant of a circle parallel to the plane of the equator, graduated in hours, minutes and degrees. When the sun rises, its shadow falls on the highest point of the western quadrant and then descends until noon. The shadow then falls at the point where the eastern quadrant meets the gnomon, rises up that quadrant during the afternoon and reaches its highest point at sundown. The hour can be read off the quadrant where the shadow meets the marked gradations. A scale of tangents on the gnomon itself allows the sun's declination to be found.

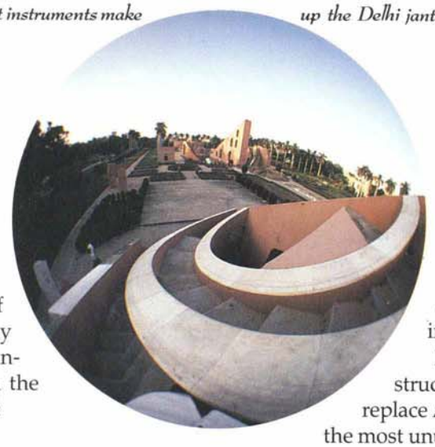
The two circular structures, open at the top, with central pillars, slatted sides and radial marble spokes, are the Ram Yantra. They are complementary, and together form a single instrument, the gaps in the sides of one corresponding to the slats in the side of the other. They were used to find the altitude and azimuth of the sun, stars and planets. The distance from the top of the wall to the graduated floor is equal to the distance from the bottom of the wall to the central pillar. The top of the wall is counted as zero degrees; 45 degrees is marked by the juncture of wall and floor. At sunrise the shadow of the pillar falls on the top of the wall, indicating that the altitude of the sun is zero degrees. As morning wears on, the shadow moves down the side of the wall; the sun's altitude is 45 degrees when the shadow meets the juncture of the wall and the floor. When it is 90 degrees – vertical – there is no shadow at all. The azimuth, or horizontal angle, of the sun may be found by bisecting the thick shadow of the pillar as it falls on the gradations on the radial spokes of the floor. The altitude and azimuth of other heavenly bodies may be read by manipulating a thread tied to the central pillar.

The last two major instruments at the Delhi observatory are the Jai Prakas and the Misra Yantra. The Jai Prakas was used to find the position of the sun by means of the shadow cast by two intersecting wires on a concave hemisphere. The hemisphere was marked with altitude and azimuth circles, tropics and declination circles.

Misra Yantra means "mixed instrument," so-called because it combines different devices in one. The complex contains a smaller version of a sundial, a graduated



Multiple giant instruments make up the Delhi jantar mantar.



semicircle for meridian altitudes, and a horizontal quadrant.

Jai Singh first became aware of advances in European astronomy while he was building the Delhi jantar mantar. As he himself says in the preface of the *Zij Muhammad Shahi*:

> *After seven years had been spent in this work, information was received that at about this time observatories had been built in Europe and that learned men in that country were carrying out this important work...and that they were constantly striving to determine with accuracy the subtleties of this science.*

He obtained – perhaps from a Jesuit missionary – a copy of the French astronomer de la Hire's *Tabulae Astronomicae*, printed in 1702 and, at a slightly later date, those of the British astronomer John Flamsteed, a colleague of Newton and Halley. Flamsteed's *Historia Coelestis Britannica* lists the positions of almost 3000 stars, for Flamsteed was able to make use of the telescope, which seems to have been unknown to Jai Singh.

Flamsteed's great work also reprinted three earlier European star catalogues, so with that of Ulugh Beg, Jai Singh had a long series of observations available for purposes of comparison. Jai Singh claimed to have found an error of half a degree in the position of the moon in Flamsteed, as well as a small error in the times of solar and lunar eclipses. He attributed these errors to European use of small instruments.

Jai Singh's own copy of Flamsteed can still be seen in the Pothi Khana at Jaipur, and he may well have owned other European works. Yet he nowhere mentions the telescope – invented by Galileo in 1609 – or the fact that more than 200 years had passed since the Ptolemaic system had been dealt its death blow by Copernicus.

Yet Jai Singh sent at least one emissary to the king of Portugal, requesting him to send an astronomer to aid him; the king did send a medical man named Da Silva who had some knowledge of astronomy. It may be that Jai Singh neglected the stirring advances that had taken place in Europe because almost all the learned Europeans he came into contact with were Jesuit missionaries, who – theoretically, at least – would have considered Copernicus, Tycho Brahe and Galileo to be heretics. The works of Galileo, after all, were not removed from the church's *Index of Prohibited Books* until well into the 19th century.

In 1727, Jai Singh began the construction of a new city, Jaipur, to replace Amber as capital; it became one of the most unusual cities in India, as well as one of the most beautiful. He built an observatory in Jaipur as well, much larger than that in Delhi and with many more instruments: the Samrat Yantra in Jaipur is over 27 meters (almost 90 feet) high and some 44 meters (147 feet) long. The observatory also includes some fixed metal instruments, including two disc astrolabes two meters (6.5 feet) in diameter. Jai Singh built three other observatories as well, at Ujjain, Benares, and Muttra, so that readings in one place could be checked against readings in another.

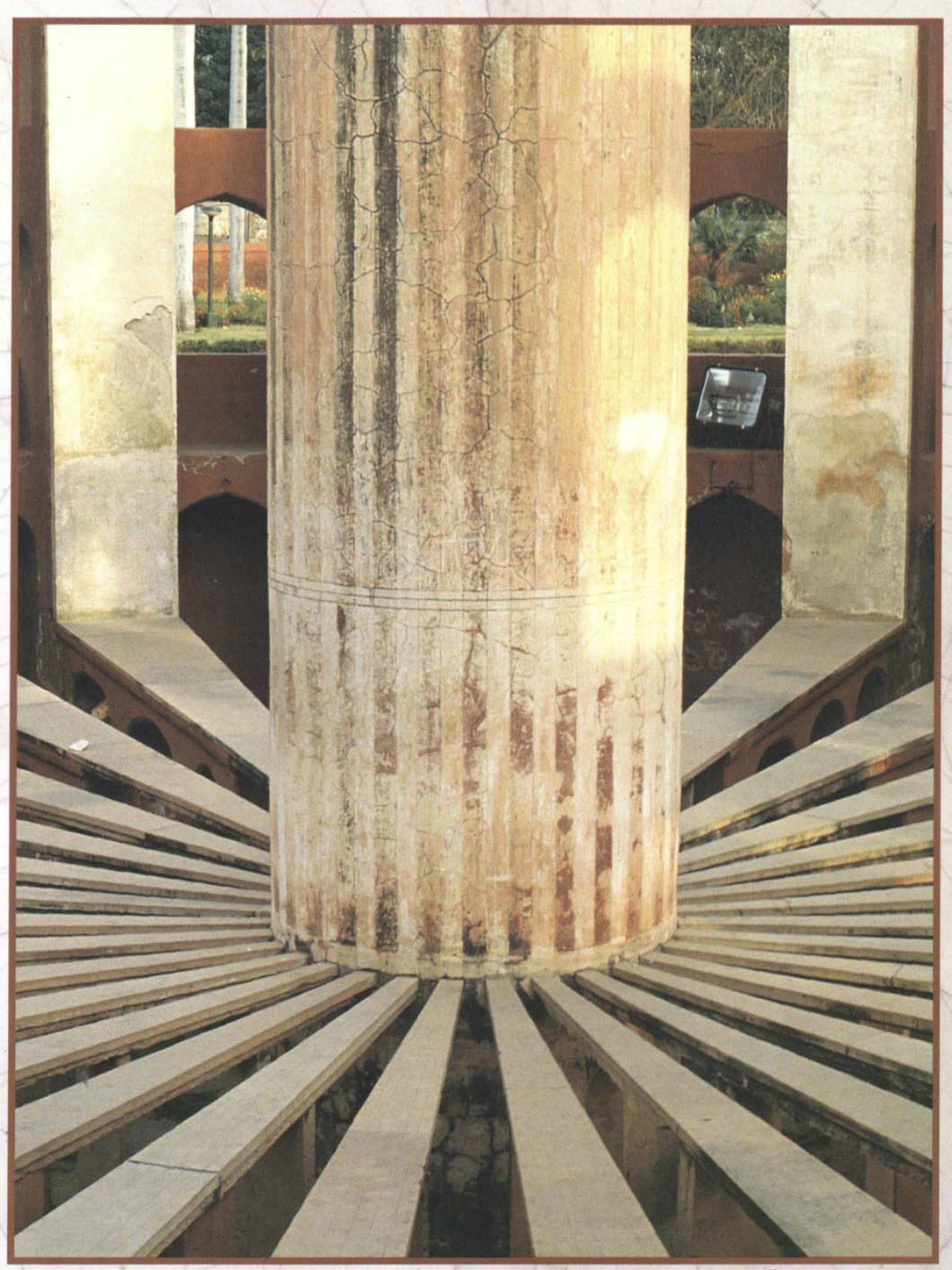
His aims as an astronomer were relatively modest, despite the size and beauty of the instruments he constructed. He wished to bring Ulugh Beg's tables up to date and if possible make them more accurate; he wished to provide almanac makers with more accurate information; and finally, he wished to be able to tell time more accurately. The Jaipur observatory was used to establish the correct time right up to 1944.

But Jai Singh was probably mistaken in his belief that large instruments produced finer readings. He knew that Ulugh Beg had used a quadrant some 55 meters (180 feet) high to prepare his tables, and was influenced by the views of Arab astronomers on the subject. Yet he seems to have been unaware that advances in European astronomy had been made by recognizing the inevitability of error and seeking to minimize it through the use of the vernier, micrometer and telescopic sight.

Jai Singh came at the very end of a tradition – the Greco-Arab – that reached back to second-century Alexandria and beyond. The study of the instruments he used and a knowledge of their limitations contributes a great deal to the understanding of pre-telescopic astronomy and the problems faced by medieval astronomers. His jantar mantar at Delhi, and its counterparts at Jaipur, Ujjain and Benares, hint at what the famous observatories of Baghdad and Maragha must have looked like in their prime.

Bibliophile and historian Paul Lunde studied at London University's School of Oriental and African Studies, and now lives in Spain.

Aramco World (ISSN 1044-1891) is published bimonthly by Aramco Services Company, 9009 West Loop South, Houston, Texas 77096. Second-class postage paid at Houston, Texas and at additional offices. POSTMASTER: Send address changes to *Aramco World*, Box 3725, Escondido, CA 92025.



Central, shadow-casting pillar of the Ram Yantra in Delhi.