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CSF

ARABS AND THE SEA

seen it from the rails of their ships — as he himself had seen it.

He reminded his listeners that Islamic naval tradition extended to their home waters. Arab warships had coursed the Mediterranean Sea, and one Arab admiral, Tariq ibn Ziyad, had given his name to Gibraltar. The Rock was originally known as Jebel Tariq (meaning "Mount of Tariq") and later was corrupted by usage into Gibraltar. Another Arab admiral, Asad ibn al-Furat, had landed invading armies on Sicily and even on the Italian mainland at the Po River.

But most of all, Ahmad ibn Majid spoke of the Arab conquest of the Indian Ocean. He mentioned the triad of sailors who had pointed the prows of their ships out of the Persian Gulf in the tenth century and helped to blaze the shoreline route to the Indus River: Muhammad ibn Shadhan, Layth ibn Kahlan and Sahl ibn Aban. He referred to bold sea captains who had braved the Indian Ocean along the shortest path to Calicut in Hindustan and then turned author to recount their experiences in writing: Al-Maqdisi, Al-Marwazi — and Ahmad ibn Majid. In these writers apprentices of the trade studied everything from star patterns over the Indian Ocean to dockside conditions at Calicut.

On one occasion Ibn Majid remarked: "Did you know that we sail beyond Ceylon to China? I myself have made the trip many times, and perhaps I may without immodesty note that I have written a couple of books about it. But our longest tradition of distant voyages links us with the land of the tiger and the elephant."

Ibn Majid advised da Gama to read *The Wonders of India* by Buzurg ibn Shahriyar. It was good advice for the book abounds in dramatic voyages to the subcontinent, in storms and shipwrecks along the way, in the salty lore of the sea. Some critics believe that Ibn Shahriyar may have influenced the anonymous literary genius who first spun the tales of Sinbad the Sailor.

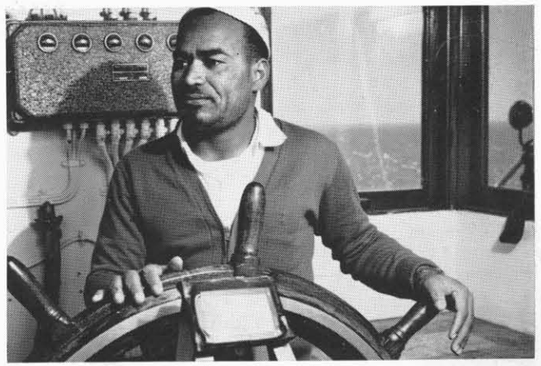
Ibn Majid did not have to spell out the reasons for Arabian interest in India. The Portuguese were well aware of it and had themselves been prompted by it to sail so far from home. Half the world wanted a share in the opulent Indian trade.

Early in their history, the Arabs living on the littoral of the Indian Ocean and the Arabian Sea had learned that they could make a profit by hazarding their lives on the deep waters beyond their shores. Seafaring families grew rich from transoceanic commerce. Splendid emporiums arose wherever trading ships came to dock — Aden, Zanzibar, Madagascar. Conversely, the seaports of the Malabar Coast, principally Calicut, became affluent from bartering with their Arab visitors.

What kind of trade? The dhows carried incense, gold, pearls, glass and ornaments of every variety. They returned with their holds full of perfume, spices, silk, cotton cloth, diamonds and teakwood. There was also a brisk exchange of animals — leopards for peacocks, and so forth.

The Portuguese had come to exploit this booming commerce of the splendid East. They became a permanent factor in the Indian Ocean after their pilot had brought them safely to landfall in the harbor of Calicut. The history of the world was to be changed by the epic of Vasco da Gama and Ahmad ibn Majid.

The man from Malindi disappears from the story in Calicut. Perhaps he found other things to occupy him along the Malabar Coast. Perhaps he got tired of waiting for the Portuguese and signed aboard a dhow headed west toward Aden or Zanzibar. Whatever the truth about him, the annals of both East and West give a prominent place to Ibn Majid the Navigator and his sea route to India. ■



Tug captain Khalifa ibn Salah relies on precision seamanship to maneuver oil tankers from many nations in and out of berths at the Ras Tanura Marine Terminal in Saudi Arabia.

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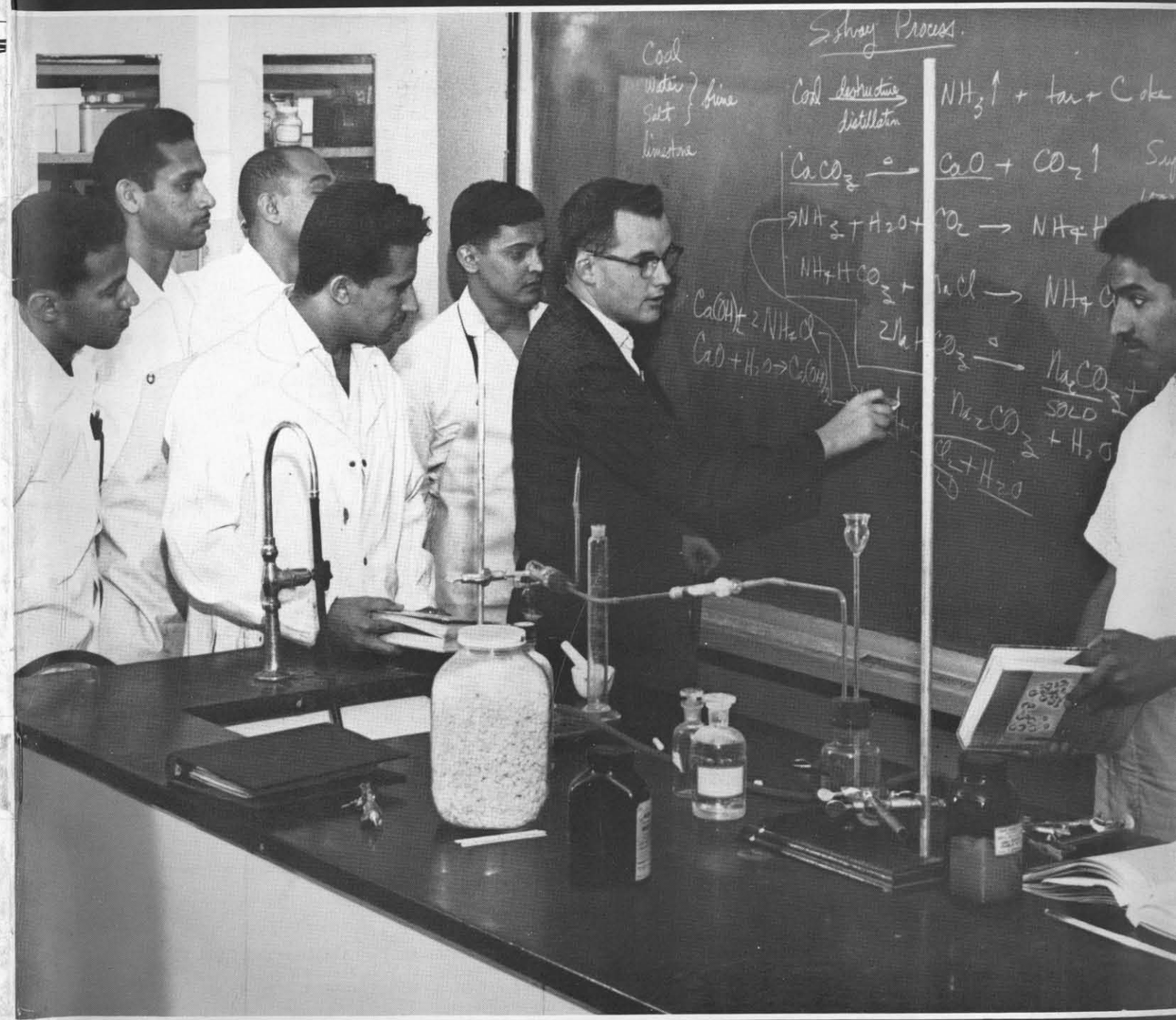

CLASSROOM SESSION FOR ARAMCO OIL MEN

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PEAK YEAR PROFILE

It was a year of achievement for the Arabian American Oil Company

FRIDAY, MARCH 24, 1961.

The morning air off Ras Tanura, Saudi Arabia was warm and humid. A light haze burned slowly away as the sun bore down on the piers and storage tanks of the Arabian American Oil Company's deepwater terminal.

A pickup truck sped along the narrow, two-mile sand causeway that links the port facilities to the desert mainland and the company's refinery.

Nine tankers, each flying a red loading flag amidships, were berthed at the two T-shaped Aramco piers. They were taking aboard Saudi Arabian crude oil, bunker fuel (some of which would power their own engines) and other refined products, all bound for distant ports.

The low silhouette of another tanker moving slowly toward the piers rose above the pale, green-blue water of the Persian Gulf. Scattered clouds hovered above. A nine-knot wind out of the northwest stirred the ships' flags. Fluttering lazily above the fantails of the array of vessels could be seen the national ensigns of Finland, Panama, Norway, Spain, Great Britain and the United States.

The world demand for oil had grown beyond the most optimistic predictions of oil men for

Bird's-eye view of the deepwater terminal at Ras Tanura highlights storage tank farm and twin T-shaped piers.

more than ten years. Nothing in 1961 better symbolized this amazing demand than the steady 24-hour flow of oil past the loading couplings at the Aramco pier on March 24.

Between six A.M. Friday and six A.M. Saturday – the official clock day of company operations – more than 1,300,000 barrels of crude oil were pumped aboard the waiting tankers. All told, 13 of the big oil cargo ships came and went.

It was a remarkable day at the terminal. A record number of tankers were "topped out" – filled to the hatches. And the terminal pumps moved a record volume of oil into the deep holds.

However, the dockside achievement was only one aspect of an historic day. Throughout the Aramco operations network – from oil fields to precisely metered storage tanks to crude oil delivery points – new high levels of oil movement were entered in log books.

Before the day began, dispatchers knew that an unusual number of tankships would arrive. But there were no changes in routine. Shift workers were at their posts, but the rest of the company was enjoying the second day of the Aramco "weekend." This was Friday, the Muslim day of rest.

As the day wore on, the meters at various delivery points showed that a record day was in the making. In round numbers, 270,000 barrels of crude oil were delivered to the Ras Tanura refinery, 203,000 flowed through submarine pipelines to a refinery on nearby Bahrain Island, and 460,000 barrels streamed into the Trans-Arabian Pipe Line bound for Sidon in Lebanon on the Mediterranean Sea.

By six A.M. Saturday the operations day had ended. The gauges and meters told the final story: 2,255,472 barrels of crude oil had been delivered from monitored storage tanks into the economic lifestream of world oil consumption.

This amount of oil, incidentally, would fill a convoy of tank trucks stretching from New York to Washington, D. C.

More than half-a-million barrels of refined products were also delivered – most of them to the 13 tankships – during the day.

Friday, March 24 may have been a routine day to the men who guided the crude oil and product deliveries, but the magnitude of the results provided the company with a difficult target for the remainder of the year. As a result, the company kept its sights high and rounded out 1961 with its highest levels of achievement.

The peak day provided the momentum for the peak year of Aramco history.

Aramco is wholly owned by four American corporations: Standard Oil Company of California, 30 per cent; Texaco Inc., 30 per cent; Standard Oil Company (New Jersey), 30 per cent, and Socony Mobil Oil Company, 10 per cent. These companies are owned by more than 1,200,000 stockholders.

Following is a summary of Aramco's record year:

OIL OPERATIONS

Annual crude oil production increased for the eighteenth consecutive year and reached 508,269,201 barrels. This was an increase over 1960 of 51,816,028 barrels.

Total cumulative production at the close of 1961, after 23 years of commercial production, was 4,764,882,568 barrels.

A factor in the record production of 1961 was the increased demand for crude oil from the Safaniya Field, one of the world's largest known offshore oil reservoirs.

● REFINERY OPERATIONS AT PEAK

At Ras Tanura the Aramco refinery processed 90,810,070 barrels of crude oil, the largest amount in the 16 years the refinery has operated. This was an increase of 10.6 per cent over 1960.

During 1961 the refinery produced 81,160,423 barrels of saleable products, of which 94.6

Tanker "Gohshu Maru" loads LPG at Ras Tanura. In December 1961 Aramco inaugurated a new operation—the sale of liquefied petroleum gas abroad. First shipment of 50,000 barrels went to Japan.

per cent were exported. A total of 3,164,490 barrels of unsaleable excess naphtha was injected into the Qatif Field as a conservation measure. Late in the year asphalt was exported for the first time.

At the company's marine terminal, a record 319,710,146 barrels of crude oil and refined products was delivered aboard tankers flying the flags of some 25 nations. The Ras Tanura terminal loaded 2,142 tankers, an average of almost six a day.

● REFRIGERATED LPG EXPORTS BEGIN

In December Aramco began a new operation: the export of an increasingly important product, liquefied petroleum gas, or LPG. The first shipment, 30,000 barrels of refrigerated propane and 20,000 barrels of refrigerated butane, went to Japan.

Completion of the plant for commercial production of refrigerated LPG at a cost of $7,685,000 climaxed a six-year effort that had required 79 "man years" for engineering studies and design alone. Located at the company's marine terminal, seven miles from the Ras Tanura refinery, the plant was designed to handle for export an average of 3,400 barrels of refrigerated LPG daily. At year's end work had begun on a project that will increase the daily capacity to 12,000 barrels.

● NEW BLENDER INCREASES DELIVERIES

A new installation contributing to increased crude deliveries at the marine terminal was a $596,000 in-line blender. This device blends different types of crude, or mixes crude with almost any product in any desired combination as they pass through pipelines en route to waiting tankers. Largest of its kind in the petroleum industry, the blender can mix as many as 20,000 barrels an hour and is operated from an electronic console about the size of an office desk.

● NEW RESERVES OF CRUDE OIL FOUND

Drilling and exploration activities during the year ranged from Safaniya in the north to the southernmost sands of the Rub' al-Khali ("The Empty Quarter"). New reserves of crude oil were disclosed in the Safaniya and Abu Hadriya Fields, and in the 'Ain Dar area of the Ghawar Field.

Total estimated proved reserves at the close of the year were 47,695 million barrels of crude oil.

Increases in estimated proved reserves over the past three years, the result of the company's continuing drilling, exploration and reservoir research programs, are shown in the following table:

Year	Remaining Proved Reserves at Year's End (In millions of barrels)
1959	38,609
1960	45,598
1961	47,695

● EXPLORATION PARTIES PROBE RUB' AL-KHALI

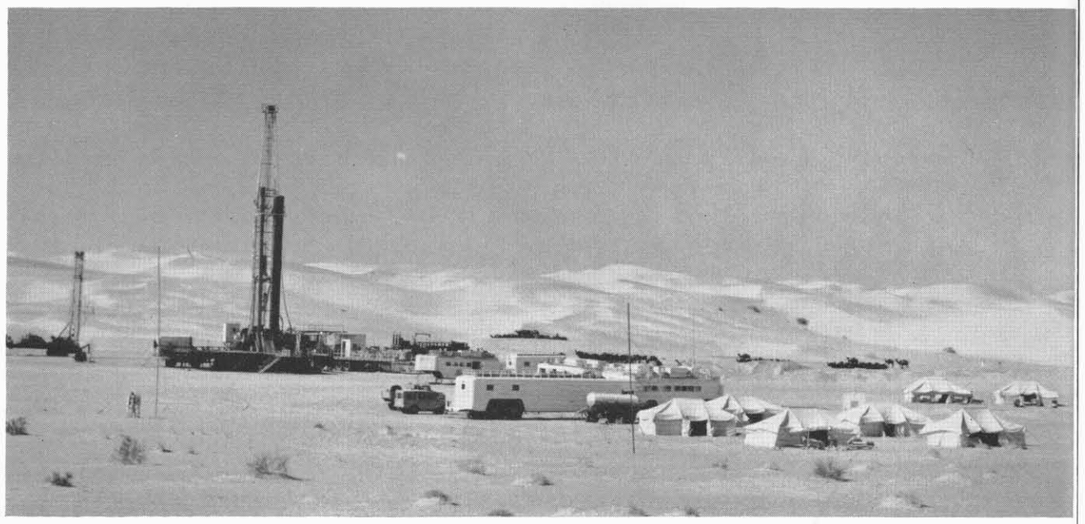
Exploration activities again centered on the Rub' al-Khali, one of the great uninhabited desert areas of the world. There, two stratigraphic-structure drill parties and two seismograph parties continued to probe an area often masked by fantastic formations of sand.

These parties, some transported and supplied by air, completed a total of 1,758 miles of seismic surveys. One seismograph party continued work in the difficult terrain of the Sand Mountains in the eastern Rub' al-Khali.

During the latter part of the year, in the offshore concession area stretching from Safaniya Field southward to the Bay of Selwa, 1,988 miles of marine seismic work were completed.

Continuing geological studies shed new light on the correlations between exposed rock formations in central Saudi Arabia and the oil-producing subsurface in the Eastern Province.

These and other exploration efforts added much to the company's and the Government's fund of knowledge of the Kingdom's petroleum potential. As in other years, Aramco kept the Saudi Arab Government fully informed of all geological findings.



Structure drill parties continued to probe the subsurface of the vast Rub' al-Khali desert in southeastern Saudi Arabia. This exploration was part of Aramco's constant quest for new knowledge about the Kingdom's oil potential.

● MORE NATURAL GAS IS UTILIZED

Programs designed both to conserve natural gas and increase the efficient production of existing oil fields were improved and expanded during 1961.

All natural gas in Saudi Arabia is produced in association with crude oil. Although crude oil production increased sharply last year, and correspondingly larger amounts of gas necessarily were produced, a greater percentage of the by-product gas was utilized. The company injected into the underground oil reservoirs, used as fuel in its own operations, or sold 45 per cent of all the gas produced. This was an increase by volume of 24.4 per cent over 1960.

Gas utilization will be further increased in the future through sales to other industries, recovery of liquefied petroleum gas, or injection.

In another program aimed at efficient crude oil production, water injection around the Abqaiq Field averaged 263,404 barrels daily in 1961. The test water-injection program begun in the 'Ain Dar area late in 1960 was continued throughout 1961 and averaged 10,892 barrels daily. In this project the injection well is opened underground to both the oil reservoir and a higher water-bearing formation. The water is thus permitted to flow downward under gravity. The water so used is unsuitable for agricultural or other purposes.

Completion of a liquefied petroleum gas injection plant in Abqaiq further expanded conservation facilities. This plant was designed to process and conserve daily 55 million cubic feet of low-pressure gases.

These gases are to be converted into raw liquefied petroleum gas and pumped through a new 32-mile pipeline to the 'Ain Dar gas injection plant. There the LPG will be commingled with injection-plant gas and pumped into the oil reservoir.

As markets become available, portions of this LPG can be transported to Ras Tanura for export as refrigerated LPG.

ARAMCO PEOPLE

At the close of 1961, Aramco had 14,066 regular employees in Saudi Arabia, of whom 10,949, or 77.8 per cent, were Saudi Arabs.

The average Saudi Arab employee was 35 years of age and had been with the company for 11 years.

For purposes of illustration, an imaginary employee might be called Sa'd ibn 'Abd Allah, and he might be a field maintenance machinist in Dhahran. He and his nearly 11,000 fellow Saudi Arab employees are vital to Aramco's success.

On a given day Sa'd may be called upon to help repair a pipeline or gas-combustion turbine. Another day he may work on equipment at the power plant, the photographic laboratory, the hospital, a water well or an air-conditioning system.

Member of a farming family in the Hofuf Oasis, the fictional Sa'd started in the oil industry as a laborer. He took a special interest in the machines he saw around him – bulldozers, trucks, heavy cranes, engines. Within a few weeks Sa'd was selected to attend general industrial training classes. For three hours every workday afternoon Sa'd studied basic Arabic, English and shop mathematics.

Some months later Sa'd was assigned to shops and maintenance work in Dhahran as a trainee. There he began to learn various machine and tool skills. Gradually he progressed to the job of field maintenance machinist.

Sa'd is a family man and the father of three children. He lives with his family in West al-Khobar, about fifteen minutes from Dhahran, in a new home of five rooms, kitchen, two bathrooms, roof veranda and walled garden.

Like more than 3,300 fellow employees, Sa'd built his house through the company's Home Ownership Program. He received the lot free, under a special Royal Grant. Construction of his home, by a contractor Sa'd selected, was financed through an interest-free Aramco loan. Sa'd eventually will repay 80 per cent of the loan in monthly installments.

Sa'd enjoys working in his flower and vegetable garden. He has both television and radio. Television offers him readings from the Koran, lectures on history by prominent Arab scholars, Arabic-English language instruction, travelogues, and health, child care and home economics programs, along with sports and other entertainment. The programs are broadcast daily in Arabic by Aramco's TV station.

Sa'd likes to swim and fish. He plays soccer, basketball and sometimes watches his friends play volleyball and table tennis.

Looking ahead, Sa'd monthly puts ten per cent of his salary into the company's Thrift Plan. The company adds reward credits to his account and, within four years, will have matched his savings.

A pension plan introduced in July 1960 automatically includes all non-American employees and credits them with past service. Sa'd has accumulated credit based on service and total earnings and will do so until he retires, with all expenses of the plan borne by Aramco. Upon retirement at age 60, Sa'd will receive a lifelong monthly pension.

During 1961 Sa'd had 28 days' paid annual vacation and special leave, and seven company holidays. His regular work week at year's end was 40 hours, with Thursdays and Fridays off.

He is protected by sickness, temporary or permanent total disability and termination benefits. Sa'd and his family receive free medical care in company-operated or designated facilities.

● TRAINING PROGRAMS EXPANDED

More than 1,400,000 hours of formal training were given within the company during the training year 1960-1961, and the out-of-the-Kingdom training and scholarship programs were broadened.

Industrial Training Center classes were held during regular working hours for an average of 2,600 employees, while enrollment in voluntary classes held after hours averaged 2,100 employees.

In the 1961-1962 academic year, Aramco sent 53 Saudi Arab employees outside the Kingdom to schools or colleges on training assignments, 34 to the United States, the rest to the Middle East.

● SAUDI ARAB SCHOOLS

Two Intermediate Schools were completed during the year by Aramco at a total cost of $721,000 and were turned over to the Ministry of Education of Saudi Arabia. One school is in Hofuf and the other in the Eastern Province capital, Dammam. Each accommodates 150 students. Aramco, which earlier built 11 elementary schools under an agreement reached with the Government, also agreed to build and maintain schools for girls in the future. Although the company builds the schools, maintains them and provides funds for teachers' salaries, they are operated by the Ministry of Education as part of the Saudi Arab Government schools system.

● SCHOLARSHIP PROGRAM

A new program offering 22 scholarships in higher education to Saudi Arab students was established during the year. Areas of study are agriculture, the sciences, engineering, teacher education, medicine (including nursing) and business management. The initial scholarships were offered at Alexandria University, American University of Beirut, American University at Cairo and Beirut College for Women. By 1963 Aramco plans to increase the number of scholarships to 60.

Aramco continued its Arab refugee scholarship program, inaugurated in 1960 and administered by the United Nations Relief and Works Agency. Thirty-six students from Jordan, Gaza, Lebanon and the Syrian Arab Republic were studying under these "Aramco Scholarships Through UNRWA" in Middle East colleges.

● HEALTH: A TRACHOMA VACCINE IS DEVELOPED

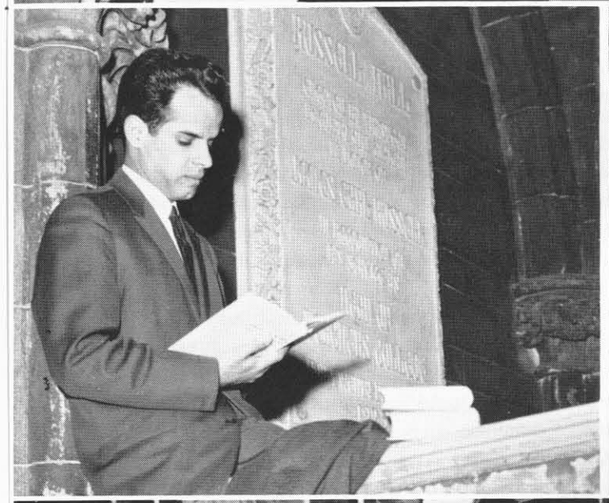
In 1955 Harvard scientists and Aramco specialists, working in laboratories in the United States and Dhahran, set out to find the causes of trachoma and ways to prevent this eye disease that afflicts 15 per cent of the world's population and is the main cause of blindness. An original five-year study was financed by an Aramco grant of $500,000.

By 1960 the Trachoma Research Program had made important gains. New procedures and techniques for combating the disease had been developed. Field studies in the Eastern Province of Saudi Arabia, Portugal, Ethiopia, Pakistan, Hong Kong and India had supplied valuable new data. An additional $585,000 was granted by Aramco to continue the program.

During 1961 definite progress and a possible break-through were made; the program reported development of a trachoma vaccine that was tested in Portugal and other areas with encouraging results. A trachoma vaccination campaign using the new vaccine was then scheduled to begin in 1962 in the villages of the Eastern Province. Directors of the program and the Ministry of Health, which approved the vaccinations, are hopeful that new gains lie ahead.

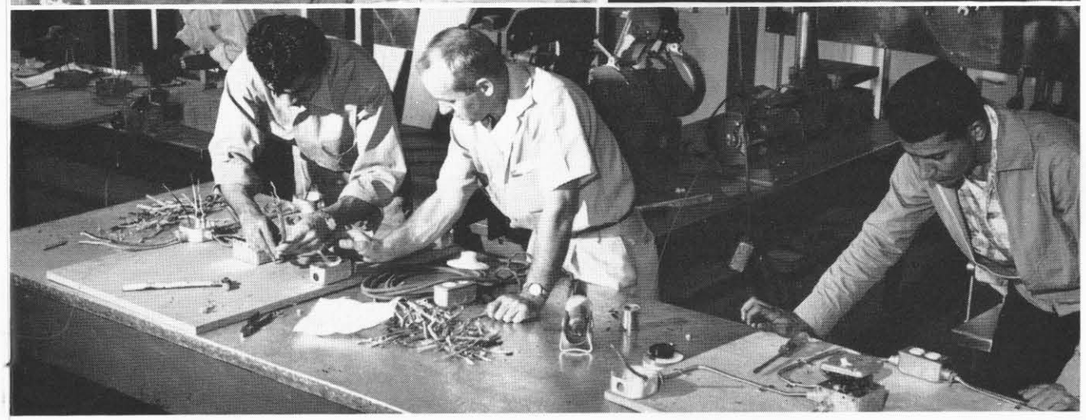
Progress was made, too, in other preventive medicine work and in family and general health education. For the first year since 1955, no case of smallpox was diagnosed in an Aramco medical facility. Employees and dependents suffered only 21 cases of typhoid, a 43 per cent drop over the average of the previous five years. Under the continuing immunization program against these and

The Intermediate School at Hofuf, which accommodates 150 students, is one of two new schools built for the Saudi Arab Government by Aramco last year.



Twenty-two new scholarships in higher education were awarded by Aramco to Saudi Arab employees like Rashid al-Rashid (left), currently studying at Columbia University's Teachers College in New York.

Aramco employee Abdulla Mohammad reassures his small daughter Fowzia as she is treated by Dr. C. F. Thomas at Dhahran Health Center.



Outstanding employees from various departments are offered 12-week courses in welding, bench work and machine maintenance at Aramco's Industrial Training School.

other diseases, more than 200,000 immunizations were provided to employees and dependents during 1961.

Control measures contributed to a decline of tuberculosis among employees; 15 cases were diagnosed against a five-year average of 55. Intensified searching for tuberculosis among dependents revealed 89 cases during the year, and plans were completed for more effective control of the disease in this group. A tuberculosis vaccine (BCG) was given selected infants.

ARAMCO AND THE COMMUNITY

The economy of Saudi Arabia was visibly expanding. New Government-built asphalt highways reached out in many directions. Commercial jet planes from many countries used the modern Dhahran and Jiddah airfields. New plants were being built. In this expansion, petroleum products played a growing part.

Sales of asphalt produced by the Ras Tanura refinery rose to 277,995 barrels in 1961. Sales of the relatively new product, aircraft turbo fuel, climbed to 117,250 barrels. In all, Aramco distributed 3,984,204 barrels of petroleum products within Saudi Arabia during the year, a 12 per cent increase over 1960.

Natural gas deliveries began in September to the Saudi Cement Company, first large industrial plant in the Kingdom to take advantage of this low-priced fuel.

Fifty-six new service stations were opened in the Kingdom during 1961, raising the total to 358. Each station is supplied by Aramco but is built, owned and operated by independent dealers.

● A VARIETY OF EXPENDITURES

As the largest company in the Kingdom and one engaged in the country's most important industry, Aramco spends large sums annually within Saudi Arabia for materials and supplies and in many other ways. For example, in 1961 the company and its employees channeled approximately $72,000,000 into the economy of the Kingdom in addition to money paid to the Saudi Arab Government in royalties and income taxes on its oil operations. This amount includes payments to, or on behalf of, non-American employees (for benefit plans, medical services, voluntary and out-of-the-Kingdom training, home ownership), payments to local industry for goods and services, income taxes paid by non-Saudi Arab company employees, public welfare expenditures, and customs, freight and miscellaneous payments to the Saudi Arab Government.

Aramco capital expenditures for new construction for the year were $26,800,000.

Payments to Saudi Arab companies for services in 1961 totaled $10,560,000. Widely diversified services provided to the company included road paving, residential land area development, printing of Aramco's weekly Arabic employee newspaper, construction of schools, installation of a large-diameter pipeline and assistance in testing, inspecting and overhauling such facilities as large refinery units.

In cooperation with the Government's agricultural program in the Eastern Province, technical advice was given to Saudi Arab farmers. These farmers achieved their most productive year in 1961; their farms yielded almost 1,800,000 pounds of produce, representing income of about $179,000. Of the total produce – lettuce, tomatoes, cabbage, carrots, onions, watermelons and other minor crops – about 25 per cent was purchased by Aramco and company employees. The rest was sold in local markets.

● PURCHASES WITHIN KINGDOM DOUBLED

During 1961 the amount of money spent through Saudi Arabian sources for Aramco supplies more than doubled, reaching a total of $11,277,000.

Items totaling $5,054,000 were purchased from Saudi Arab suppliers for the first time. These included large-diameter pipe, casing, valves, catalysts, drilling additives, steel plate and sheets, new types of automotive vehicles, bronze tubes, rock bits and chemicals.

Twenty-five miles off the Saudi Arabian mainland, around-the-clock crews were drilling Safaniya Well No. 46 and putting down new underwater pipeline. Eighty miles to the south, other drilling crews bored Abu Hadriya No. 12 into the center of an oil reservoir to be produced in the months ahead.

In the Rub' al-Khali, where the unknowing visitor may suspect he has landed on the eerie, wrinkled surface of the moon, exploration parties were pushing northward, having completed geological reconnaissance of the vast area.

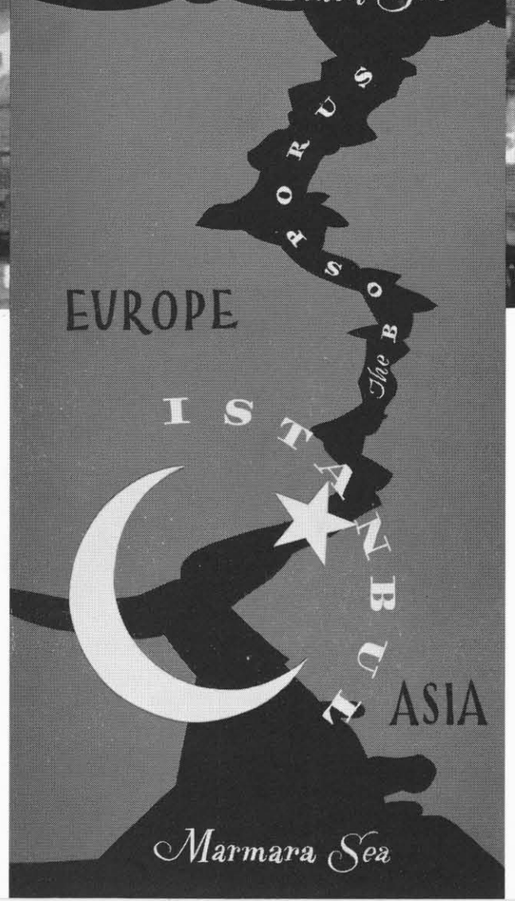
On drafting boards in The Hague, Netherlands, engineers were designing equipment that will more than triple refrigerated liquefied petroleum gas capacity. In Dhahran negotiations were being completed for the purchase through a local businessman of more than a million dollars worth of pipe to be fabricated in Japan.

At Perth Amboy, New Jersey, harbor experts were ready to train two Saudi Arabs as berthing masters. At Columbia University's graduate school in New York, a Saudi Arab employee was studying education administration. At Beirut College for Women and the American University of Beirut, two young Saudi Arab women on Aramco scholarships were preparing for teaching careers. At the A.U.B. medical school, another Saudi scholarship student was working toward a career in medicine.

The year 1961 was ending. Aramco and its employees were moving into a new year, toward new challenges. ■

At Dhahran, Aramco employees cross street at safety zone. Of 14,066 regular employees, 10,949, or 77.8 per cent, are Saudi Arabs.

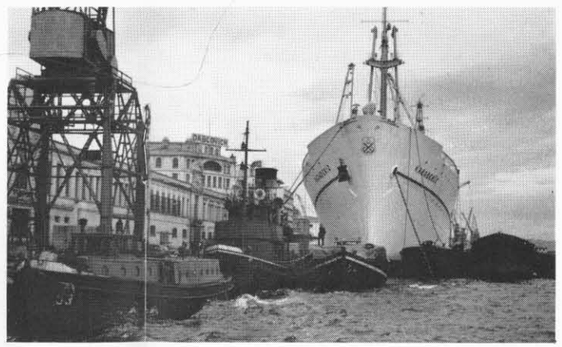
Galata Bridge spans the waters of the Golden Horn, connecting Old Istanbul with Galata, the business center in foreground.



Istanbul University, erected by Sultan Mehmet II, the "Conqueror," in fifteenth century, serves about 30,000 students.

Istiklal Caddesi (Avenue of Independence) is fashionable shopping area of Beyoglu district, where hotels and entertainment spots are found.

Galata Tower, high above the commercial area, was built by Emperor Zeno in fifth century. A thousand years later the Genoese used tower as lookout when they defended Istanbul.



Ships from around the world call at Istanbul, continuing city's ancient role as trading post for Europe and Asia.

Istanbul

crossroads of two continents

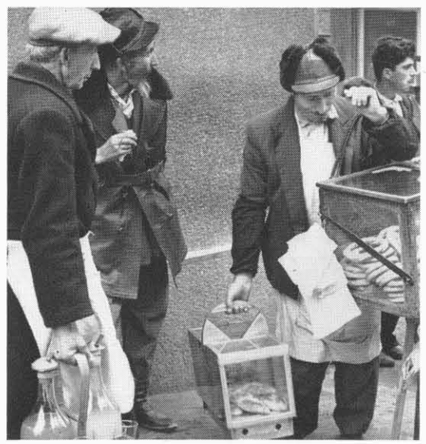
THE YEARS have been gracious to Istanbul. Drawing her age about her like a cloak woven from the strands of 26 centuries, the Turkish city stands astride the Bosporus in quiet dignity. The swift waters of the Bosporus, a 20-mile strait connecting the Black and Marmara Seas, bisect the ancient city at a point where Europe and Asia touch. Because of its strategic location and protected harbor, called the Golden Horn, Istanbul has been the cornerstone of four civilizations. The first settlement dates to the seventh century B.C. when Byzas, leader of the Megarians, expanded a sleepy village into Byzantium, jewel of the Byzantine Empire, bequeather of a rich architectural heritage to succeeding generations. After the decline of Rome, when its senate ceased to be sovereign of the far-flung Roman world, Emperor Diocletian divided the burden of government among four colleagues. One of them, Constantine the Great, was charged with administering the Eastern provinces. Choosing Byzantium as his capital in 330, he named it after himself – Constantinople. For 1,100 years Constantinople thrived as a great commercial, legal and ecclesiastical center. Then, in the thirteenth century, the city was overrun by Crusaders and not until 250 years later, when Sultan Mehmet II, the "Conqueror," styled it capital of his Ottoman Empire, did the city regain its former glory. Although the "queen of cities" is no longer Turkey's capital (Atatürk called it Istanbul and moved the capital to Ankara in 1922), the city's diverse cultures, acquired through 2,600 years of alternating Eastern and Western influence, combine to lend Istanbul a unique cosmopolitan flavor. As the Turks put it: "If one had but a simple glance to give the world, one should gaze at Istanbul."

ISTANBUL

For salesmen without shops, Istanbul's thoroughfares serve as display cases. Photographs of national heroes are always in popular demand.

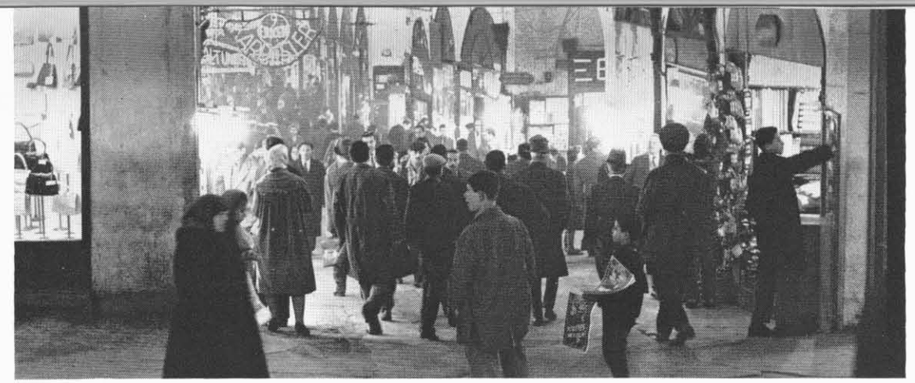
Turkish girls in local costume pour thick, sweet Turkish coffee for guests at an Istanbul hotel. The coffee ritual, traditional throughout the Middle East, symbolizes warm hospitality.

Correspondents in a hurry call on street corner scribes who will typewrite a letter while the customer waits. Open-air scribing dates to ancient times.



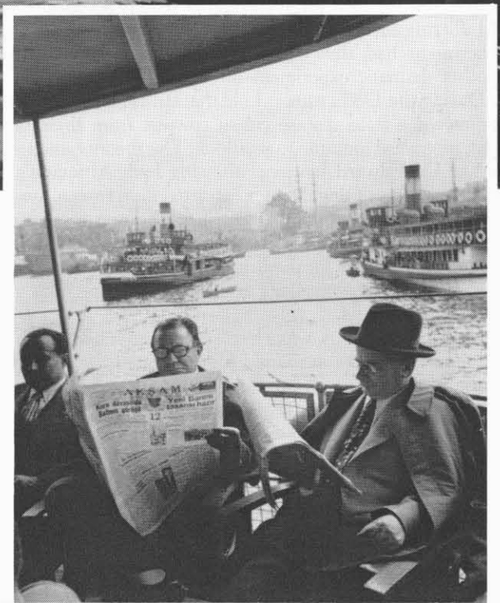
Roving vendors stock sweets and soft drinks for on-the-spot refreshment.

The Grand Bazaar, a city within a city, teems with merchants and craftsmen of many trades. Its 4,000 shops are open from sunrise to sunset.



Boatmen on the Golden Horn row against the backdrop of Old Istanbul. The name Istanbul comes from the Greek for "to the town" and probably came into common usage when there were no other major cities nearby.

Both shores of the Bosporus are lined with suburban communities whose residents commute to work by ferries, which depart from Galata Bridge in European Istanbul and Uskudar in Asia.



Each year medical researchers add new chapters to the old story of

VACCINES

"BRING THE PRISONERS before us," commanded the king, and soon six doomed felons knelt at his feet. "We give you a choice," he said. "You may die as scheduled, or you may take a chance that will mean pardon—or death more horrible than hanging."

It was 1717 and George I sat on the throne of England. The country was ravaged by smallpox, and the disease claimed hundreds of victims each day. Highly contagious, smallpox at that time was usually fatal. As a consequence, victims were often deserted by their own families.

Early that year Lady Mary Worley Montagu, wife of the British ambassador to Turkey, had written a letter in which she described "an ancient Turkish art called ingrafting." To protect themselves against smallpox, she wrote, the Turks called in an old woman who specialized in healing. With her she brought a needle and "a nutshell of the matter of the best sort of smallpox." Opening a patient's vein, the woman injected "as much venom as can be had upon the head of her needle." Lady Montagu added: "There is no example of anyone that has died [of the practice] and I intend to try it on my dear little boy."

The letter caused a sensation in England and prompted King George's experiment. The half-dozen convicts submitted to the ingrafting. All came down with mild fevers, after which all developed a few pocks. But then the fever suddenly subsided, the sores disappeared. In a few days all were completely recovered!

The prisoners had won their freedom, and medicine had taken its first step toward vaccination – the process of provoking a mild infection in order to make a person immune to later, uncontrolled attacks of the disease.

That such immunities to disease existed had long been known. Historian Thucydides noted 2,500 years ago that a plague which wiped out a quarter of the population of Greece during the Peloponnesian War affected people only once. Those who recovered never fell prey to it again. In China mothers wrapped their babies in clothing taken from the bodies of smallpox victims. The infants contracted the disease, but if they recuperated they never needed to fear smallpox in the future.

In England, however, men did not readily accept the idea of inflicting themselves with smallpox, even after the king's experiment had shown it to be safe. But 70 years later another dramatic experiment finally convinced them.

During the 1780's rumors held that British milkmaids who contracted a mild disease called cowpox from their herds were afterward immune to smallpox. The theory came to the ears of Dr. Edward Jenner. Following Lady Montagu's description of ingrafting, Jenner extracted fluid from a cowpox sore and transferred it to a scratch on the arm of an eight-year-old boy, who fell ill with cowpox, then quickly recovered. It was time for the dangerous part of the experiment – scratching the youngster's arm again, this time with virulent smallpox fluid.

For weeks the boy was closeted in Jenner's home. Each morning the doctor examined him for smallpox symptoms. None appeared. Jenner infected the lad again; still no symptoms were visible. Only then did Jenner reveal that he had succeeded in testing the world's first safe protection against infection by a virus disease. The very words vaccine and vaccination commemorate his break-through. Both derive from the Latin word for cow, *vacca*.

Today doctors know that Jenner was incredibly lucky. He did not know that cowpox and smallpox are not caused by the same agent. Nor did he know that cowpox is one of the very few mild diseases that can create immunity to a different, more serious malady!

A more typical instance of vaccine development was the experience of Louis Pasteur, who worked to develop a preventive for rabies in dogs. Pasteur could discover no disease that acted as cowpox did with smallpox and was forced to work with the deadly rabies virus itself.

It took years of experimentation before Pasteur found a method of handling rabies virus safely. He injected rabbits with the blood of rabid dogs. After the rabbits contracted the virus and died, their infected spinal cords were dried and ground. In this form the virus was "attenuated" – still alive but changed or modified so that although it retained enough of its original characteristics to create an immunity it could no longer cause rabies itself.

Neither Jenner nor Pasteur knew that the diseases they helped to conquer were caused by viruses too small to be seen by ordinary microscopes. The existence of viruses was not established until 1898, three years after Pasteur died. Neither did these two pioneers know much about how the body becomes immune to disease – a process just being explained today.

The process is launched when foreign proteins are introduced into the body. In some unknown manner they are detected, and the body starts the manufacture of antibodies, or counteracting substances.

Once in existence, antibodies act like defending armies and neutralize the invading bacteria or viruses. If the invasion is large enough, the antibodies cannot neutralize all the disease agents and the person contracts an illness. If the attack is small, as in the case of a vaccination, the disease is defeated. Like any victorious army, the supply of antibodies occupies the conquered territory after the enemy is vanquished. It is this extra supply that protects us from further attacks of the same disease.

Arabian American Oil Company medical technician vaccinates a youngster against smallpox. Over 200,000 immunizations were provided to Aramco employees and dependents in 1961.

Producing vaccines is a painstaking process. Typical of egg vaccine production is the procedure for influenza vaccine in which four strains of virus are raised and modified separately, then mixed together.

Production of the vaccine starts with the incubation of eggs for 11 days until the chick embryos have formed. Eggs containing healthy embryos are disinfected with iodine, then punctured with a drill. A solution containing one of the strains of virus is injected, after which the puncture is sealed.

Eggs are then returned to the incubator for 48 hours, after which they are again inspected. Those in which the embryos are still alive are chilled, then "harvested." A portion of the shell is burned away and the virus-laden fluid is syphoned into sterile containers to be rechilled. Then the virus is separated from the egg fluid in a centrifuge machine.

The virus is next placed in a chemical solution which inactivates it, then is chilled again and inspected for sterility. Only after all this can it be combined in a solution with the other virus strains to create influenza vaccine.

Another virus vaccine produced in an entirely different manner is polio vaccine. In 1949 Dr. John Enders of Harvard University found that polio virus could be grown in test tubes on a tissue culture of monkey kidney cells. This was the first practical means of growing the virus in quantities that made a vaccine feasible. Enders' work paved the way for Dr. Jonas Salk, who conceived the idea of growing the three strains of virus comprising Salk vaccine separately, inactivating them with formaldehyde and combining them into a complete vaccine.

Most of the procedures used for Sabin's oral live-vaccine are similar to those used in Salk killed-vaccine. In the Salk vaccine the virus is inactivated; in the Sabin vaccine the virus is live, though attenuated, and must be constantly checked to see that it doesn't change form.

Technicians begin the process by mincing freshly removed monkey kidney, which is then agitated in an enzyme that causes the fragments to break down into separate cells. The process is repeated until the kidneys are completely separated.

A concentration of the cells is inoculated into flasks of nutrient material. These are incubated for seven days during which the cells multiply and form a thin layer of tissue. If the tissue culture has grown properly and is free from contamination, it is placed in fresh medium.

Fluids from each flask are pooled and added to a series of tissue cultures in a test for living microbiological agents. If pure, they are passed to the live virus area. Here one of the three polio viruses is added to the tissue culture. During a three to four-day incubation period, the virus invades the cells, thrives and multiplies. The virus-laden fluid is harvested and stored in deepfreeze for ten days. If no active agents are detected in any of several control tests, samples of the vaccine undergo tissue culture testing, sterility and potency checks. Then the individual strains are combined.

Vaccine making is conducted in the same sanitary atmosphere found in hospital operating rooms. All equipment is constantly sterilized; ultraviolet rays purify the air; workers wear sterile clothing, goggles, gloves and face masks. Walls and floors are scrubbed to aseptic cleanliness.

Although it is impossible to calculate the amount of suffering these vaccines prevent each year, a population expert has estimated that vaccination "ingrafting" has saved at least 30 million lives in the past 150 years. Mankind has reason to be grateful to King George's six convicts. ■

ON LOCATION IN SAUDI ARABIA

Cameraman and director examine one of film's storyboards, a visual shorthand for planning camerawork. Each sketch in the sequence will become a scene in the finished film.

Photography by **T. F. WALTERS**

Long before the cameras roll, months of creative planning go into making an Aramco documentary film

SCENE: Interior of a small wooden building. Offices, hallway, desks, bulletin boards, typewriters, usual office paraphernalia. Large cork panels on walls in several of the rooms. Disarray of artists' materials, semifinished sketches, oil field mock-up. The low building, weathered by the intense desert sun, is like a dozen others nearby. But there is a difference, a temporary distinction. Taped to a pane of glass in the front door is a sheet of theme paper, slightly askew. It bears a hand-lettered, lightly ironic legend – *MOVIELAND.*

PLACE: Dhahran, Saudi Arabia. Headquarters of Aramco – the Arabian American Oil Company.

TIME: Afternoon, late February 1962. Morning, early April 1962. And the present.

OPENING SHOT: Writer at work. Desk covered with research based on location visits and hours of interviews with Aramco experts. Behind the writer a storyboard is tacked to a five-foot-high cork panel.

CLOSE-UP: Writer typing. Words form across the page. They look like free verse. Their odd syntax reveals the great difference between written and spoken words.

The writer *listens* to what he is writing. His trained imagination hears the narrator whose voice, months hence, will be blended into the sound track of the film. Unlike children, a filmscript is to be heard and not seen.

Oil from Safaniya (he writes) *is heavier than most – containing a larger proportion of fuel oil – helping the company supply a growing demand.*

The writer turns to the storyboard. He checks frames 105, 106, 106a and 107. His lips barely move as he reads the narration he has just completed. A stop watch in his right hand sweeps through a rough time estimate.

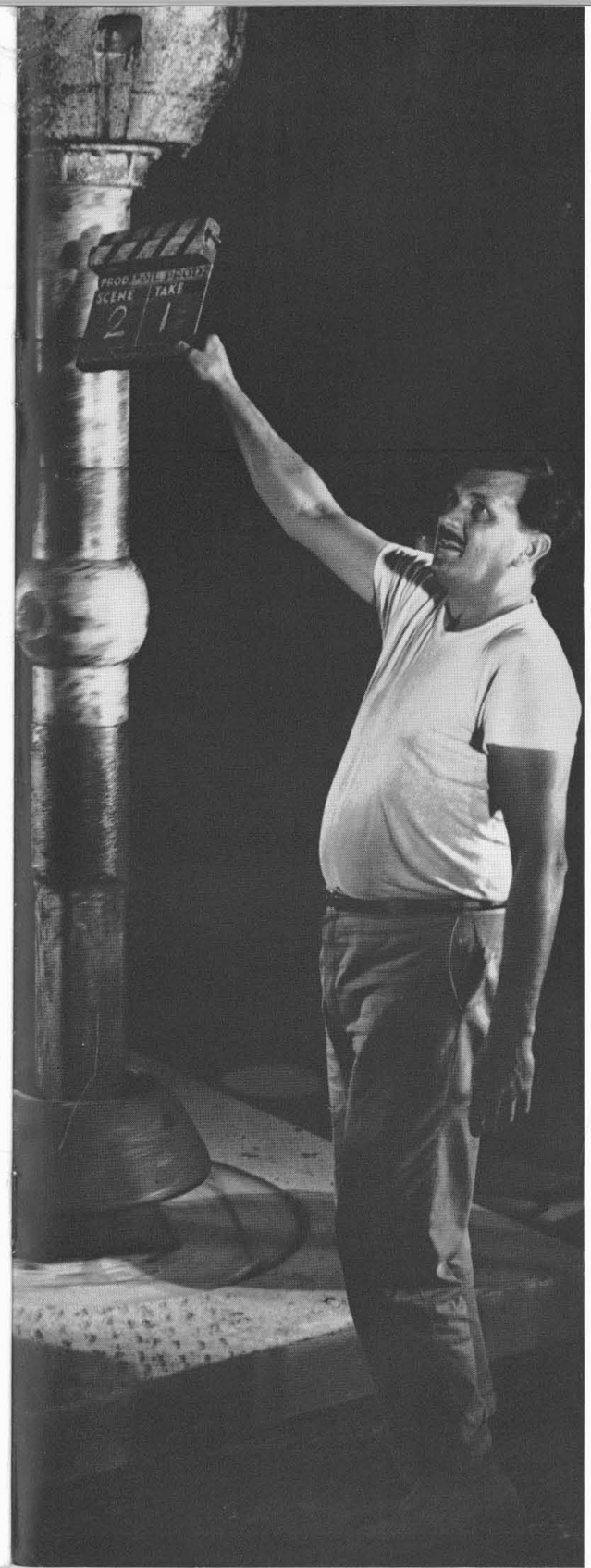
The camera closes in on the frames of the storyboard. Each frame is a separate scene. Each shows a simple sketch, a visual shorthand for planning and filming. In scene 105 a man turns a valve on an oil well in the fabulous Safaniya Field. In this case nature, and not Hollywood, provides the adjective. Safaniya may well be the world's largest submarine oil reservoir.

The valve in scene 105 is on a platform above the water of the Persian Gulf. Scene 106 shows only water and bears the terse note "travel." In the next sketch a pipeline heads shoreward under the water. Scene 107 rounds out the sequence with a shot of the Safaniya gas-oil separator plant (a "GOSP" in engineering lingo).

The stop watch indicates that the narration falls within the allotted time. On a pad the writer notes: "February 25, 1962. 107 scenes complete." There are 114 to go.

(*TIME LAPSE:* A flurry of desk calendar pages, quick blur, then, April 3, 1962.)

SAFANIYA SHOT – MORNING: A silver DC-3 banks low over the shoreside camp. It swings in a wide arc out over the Persian Gulf. The silhouette skims swiftly over the wind-feathered green-blue water.



With camera in position, the film crew gets ready to shoot a transportation scene. The director hunches over to test camera angle he had previously envisioned on the storyboard.

Scene-and-take slate is held aloft in camera range just before filming starts on a drilling rig sequence. The camera films the slate; then each time the scene is repeated, the "take" number is changed accordingly. Data, recorded on the film itself, facilitates editing of exposed footage.

INSIDE THE PLANE: Close-up of cockpit. Co-pilot seat is empty. Extended legs of a tripod cover the empty seat.

The cameraman checks the multiple lens settings and scans the tiny platform islands that dot the water. He points to one. The pilot nods. Another banking arc and the plane is on a direct heading from the well to the onshore GOSP.

The DC-3 streaks low over the well-head platform and follows a hidden pipeline that carries oil from the well to the GOSP. A "travel" shot. The camera eye records the dramatic sense of flow as suddenly the shadow of the plane leaps from the green-white sea edge, swings over the beach and climbs the silver units of the GOSP.

Six times the DC-3 courses over the Persian Gulf at Safaniya to bring to life scenes 106, 106a and 107 of the Aramco storyboard.

SAFANIYA CO-ORDINATING SHOT: Meanwhile, another section of the experienced movie crew moves out into the Gulf on a company launch. Theirs is the job of filming scene 105 – the man turning the valve on the platform. By day's end the Safaniya sequence is complete.

The foregoing movie-within-a-movie presents only two brief scenes in a long scenario that covers many months – the making of an Aramco documentary film. Planning started long before the advance group – producer-director, artist, writer – arrived in Saudi Arabia. Work on the produc-

ON LOCATION IN SAUDI ARABIA

Director reaches out of darkness to order change in lighting as crew prepares to film Aramco's President Thomas C. Barger (right) and Senior Vice Presidents Paul H. Arnot (center) and Robert I. Brougham.

tion continued long after the final aerial pass over the Safaniya GOSP.

Aramco uses film entertainment to teach, thus applying a suggestion made by Lucretius in his masterpiece, *De Rerum Natura,* about 60 B.C. The Roman poet-philosopher charged science with the responsibility of interpreting its mysteries to the layman and advised scientists that they would do well to use popular techniques – to "put a little honey on the lip of the cup."

After more than a decade of film making in the Middle East, Aramco has evolved an audience target. At the center are the nearly eleven thousand Saudi Arab employees of the company, the teachers and school children of the Kingdom, and the country's officials and merchants.

Beyond the visual pleasures they provide, the films have an important place on the balance sheet of industrial progress in Saudi Arabia. They serve a set of unusual conditions.

In the first place, oil is Saudi Arabia's number one industry. And to all but a few men in the world, oil is a terribly complex industry that is hard to understand.

Consider this fact. The oil industry finds and converts a raw material of growing importance the world over. The world spins around on oil, yet few people ever see it.

Now mix in the mysteries of science. Chemists, physicists and engineers carry out oil's wide-ranging research. Their work is baffling. So are the strange processes they create that change crude oil into fuels for ships, stoves and spacecraft.

The magnitudes of the world petroleum industry are truly overwhelming. Some tanker fleets are larger than merchant fleets. Some vehicle fleets are bigger than those operated by transport companies. And the capital investments of oil companies fatigue the eye with their strings of zeros.

By any standards, oil is indeed a complicated business.

Now add to these complexities the fact that Aramco trains thousands of Saudi Arab employees for increasingly responsible assignments and the fundamental significance of its documentary films becomes clear.

The Aramco films interpret to the Saudi Arab audience the nature of its most important industry. And they provide employees with a framework for understanding how their jobs fit into the free world petroleum industry. All in basic visual terms that entertain while they teach.

Each film is planned in the Aramco public relations department. First a story idea is developed. Then the advance movie crew arrives to research the story, write the scenario and prepare the storyboard.

Aramco experts provide authoritative guidance every step of the way. The problem of creating an interesting, accurate and entertaining film is in the lap of the film crew. They bring to their task considerable experience in the motion picture arts: casting, staging, design, lighting, sound recording, filming, animating and cutting.

During the research phase the producer-director makes frequent use of a Polaroid camera to capture details of actual locations. He also photographs dozens of Aramco people at work. From these pictures the cast of characters is chosen.

When the storyboard is finished, it is presented to Aramco for executive approval. The hundreds of sketch scenes are laid out in sequence and the narration is read aloud.

Once approved, the numbered scenes are then cut apart and reassembled in functional sets. For example, all aerial scenes will be grouped and scheduled so that maximum use can be made of plane and pilots on a given day of flying.

Final production takes place in New York, where all the film shot on location (sometimes as far afield as Norway and Singapore) is assembled along with the sound recordings. Animation sequences based on field sketches are then executed in detail. The film is edited, the sound blended with the narration and musical underscore, and the "green cut" of the new motion picture is readied for executive review.

Distribution is made simultaneously in both 16-mm and 35-mm versions to a number of audiences. Employees get the first look. Then showings start in the schools of the Kingdom. Next, because of the growing interest in oil in the Middle East, the film is shown in motion picture houses in Egypt and Lebanon, usually as part of a double feature. The picture is finally scheduled on television in both Saudi Arabia and the United States.

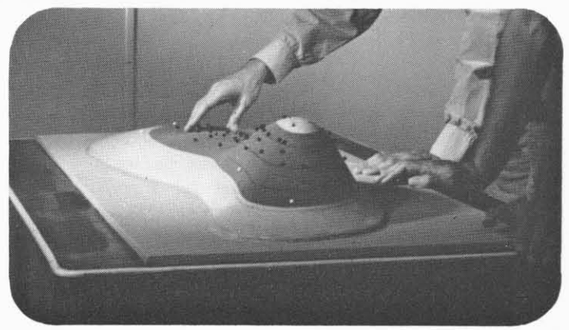
Two Aramco documentary films in the company's present series have been released – two more are well along in production for future release. The first of the new series – "The Science Of Oil" – has been something of a hit for many months both with employees and the general public.

The second film in the series – "The Explorers" (the story of the search for oil) – is currently moving outward from the center of Aramco's distribution target.

CLOSING SHOT – NIGHT – A DESERT EXPLORATION CAMP AT HARADH: A 16-mm projector whirs. Saudi Arab employees watch the color movie as it tells the story of the science, the technology and the Arab-American teamwork in Aramco's continuous search for oil beneath the desert sands. There is a burst of animated discussion. On screen a sand mountain rises hundreds of feet above the desert floor in the Rub' al-Khali, the world's largest sand desert. Nearby is a cluster of tents and trailers. The scene is familiar to many of these men. They have worked there. Now a sudden peal of laughter. On the screen looms a familiar face.

The film ends, the whirring stops. But another sound replaces it – the sound of many voices urging in Arabic that the film be shown again, *immediately*. The machine whirs once more and the film is rewound. All sit down. Again the title flashes on the portable screen. The sound fills the night. All watch with family-album anticipation. . . . ■

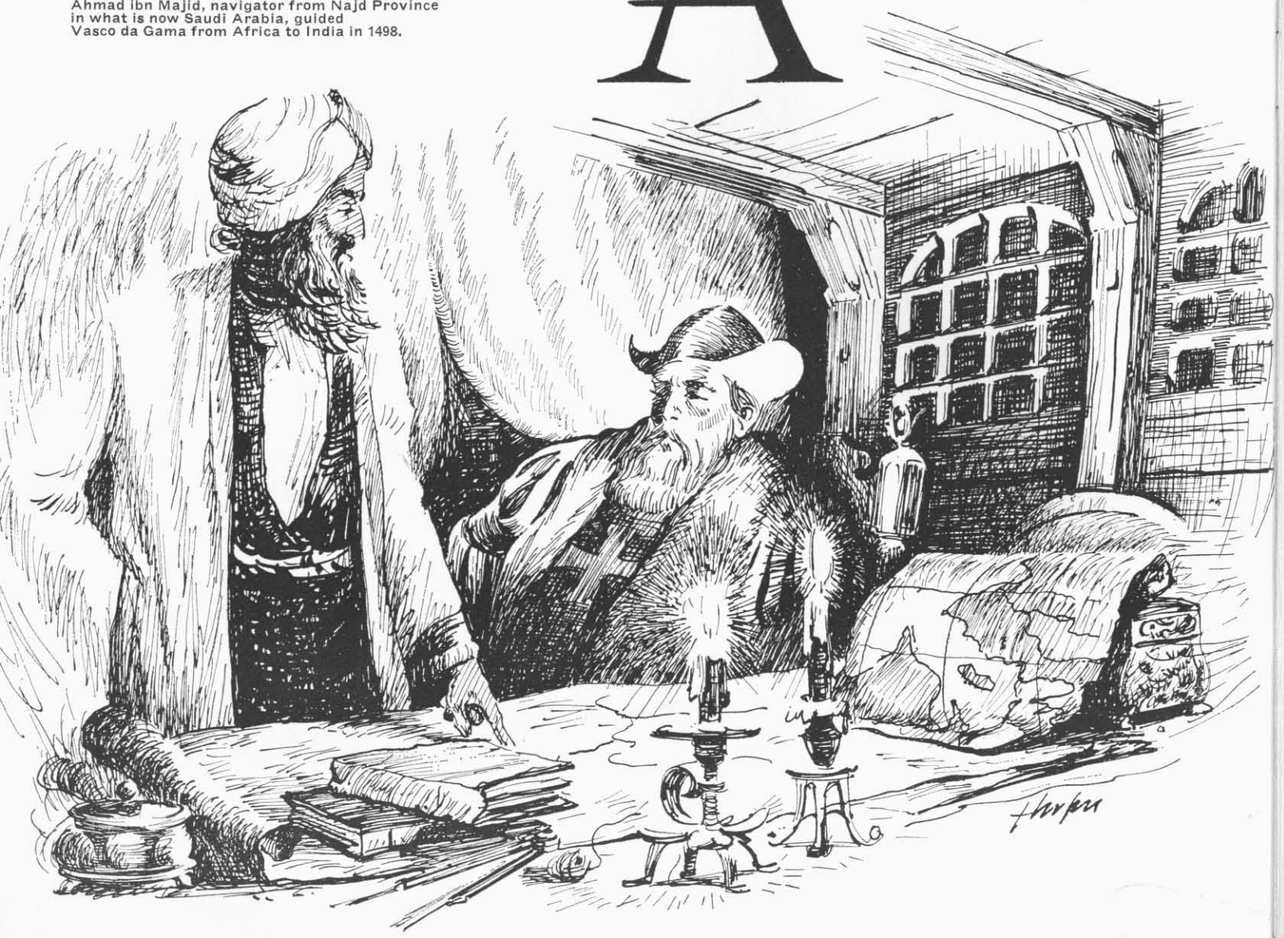
Special effects team creates a scene that allows audience to "see" into the earth. At left, artist Gene Tourville finishes a realistic scene of a drilling rig at work above layers of rock strata. After scene is positioned and lighted (right), the camera moves in slowly on the sandy foreground and then travels upward to focus on the rig itself.



After filming the rig, the camera pans down through the rock layers toward the oil-bearing strata. As camera nears bottom of drill-hole, film consultant Ray Graham prepares to remove artwork on cue from director Richard Lyford (center background of left photo), revealing a three-dimensional model (right) of an actual Saudi Arabian oil field deep in the ground.

Arabs and the Sea

Ahmad ibn Majid, navigator from Najd Province in what is now Saudi Arabia, guided Vasco da Gama from Africa to India in 1498.



By the time Vasco da Gama rounded the Cape of Good Hope, Arab sailors were already masters of the Indian Ocean

"MASTER NAVIGATOR," said Vasco da Gama, "we have a strong wind behind us. How long will it blow?"

"Sir Admiral," replied Ahmad ibn Majid, "it will continue for another month. It is what you Europeans call the monsoon, which in turn comes from our word *mausim*, meaning 'season.' This monsoon blows steadily toward India for six months of every year. We will ride it straight on to the Malabar Coast."

The words of the Arab pilot were exactly what the Portuguese sea captain wanted to hear. Vasco da Gama was in a hurry. It was April of 1498. He and his men had rounded the Cape of Good Hope in search of a sea route to India. They had reached Malindi below the Horn of East Africa and then were forced to drop anchor, for, as the first Europeans in these Islamic waters, they dared not venture out onto the broad expanse of the Indian Ocean without a navigator schooled in the sea.

Da Gama was fortunate. He found in Malindi the most illustrious Arab navigator of the time. Ahmad ibn Majid, weather-beaten veteran of half a century at sea, had sailed the Indian Ocean from shore to shore. His coal black eyes and steady hands had steered ships into the mouths of the great rivers – the Zambezi, the Tigris, the Indus. He could number the shoals off Mozambique. He could describe the best landfalls on both sides of the Red Sea. And so skillful was he at piloting argosies on the open-sea run from Malindi to the Malabar Coast that his services were constantly in demand by the prosperous merchants of Arabia and Africa.

"The sea route to India is easily managed," declared Ahmad ibn Majid, "if one has ability, courage and science." He himself enjoyed all three.

Moreover, he was willing to place his nautical virtues at the disposal of the Portuguese, to whom he was already known by name. Even in far-off Europe they had read Ibn Majid's *The Advantages of Knowing the Sciences of the Sea,* an internationally celebrated sailors' handbook. Da Gama and his officers had studied it. Now the author came aboard their flagship armed with highly technical maps and charts of the Indian Ocean. He plotted for them the route between Malindi and Malabar. He proved that he could handle relatively new instruments like the compass and the astrolabe, forerunner of the sextant. He spoke with expert precision of vectors, tides and Indian seaports. He revealed a seaman's intuitive understanding of what their ships, completely new to him, could and could not do.

The result was a quick bargain. The anchors were lifted, the sails unfurled and the Europeans, with their Islamic navigator barking instructions in the pilothouse, were on their way to India.

Before the voyage was over the admiral and his navigator had developed an enormous respect for one another. They talked endlessly of naval matters through their interpreter. One of the topics that came up time and again was the chief problem of sailing ships – the wind, in this case the monsoon.

Ibn Majid described the remarkable meteorology of the Indian Ocean and the way in which Arab sailors had been exploiting it for centuries. He knew no scientific explanation for the phenomenon of the monsoon, not at all surprising since even today there are mysteries about it. All we can say for sure is that the monsoon is due to climatic conditions in southern Asia. One theory is that the summer heat of India causes the air to rise over the subcontinent, creating a vacuum into which rush the winds from the Indian Ocean. By the same token, the comparative coolness of the Indian winter causes a reverse monsoon from India to Africa.

The Arabs had known since ancient times that they could rely on prevailing winds for long voyages beyond sight of land. The Portuguese were surprised to hear this, for they did not relish the idea of going to sea in an Arabian *dhow*. It was a natural misapprehension. The Europeans did not understand the merits of the dhow as an oceangoing vessel – merits as distinct as those of their own larger ships.

The Portuguese had constructed their fleet expressly for the circumnavigation of Africa. Similarly, the Arabs had built theirs for use in the Indian Ocean and the Arabian Sea. They needed craft small enough to be light and maneuverable. The answer to their specific problem was the dhow.

Usually constructed of coconut wood or teak, the hardest and most durable timber, the dhow was entirely seaworthy amid the comparatively mild waves of the Indian Ocean. Its light bulk allowed it to travel with speed so that it could scud out of the path of threatening weather. Its triangular lateen sail was adapted to catch the slightest breeze and lend the ship maneuverability in treacherous coastal waters.

The planks of the dhow were stitched rather than nailed, because nails were not common in Arabia. Islamic shipwrights ingeniously fastened the planks to one another, and to the keel and ribs, with twisted cord. They caulked the hull with a heavy coat of mixed whale oil and pitch and rendered the vessel sufficiently watertight to keep the hold dry. Even perishable goods could be transported safely.

The worth of the dhow is proved by its longevity. Old in da Gama's time, it has lasted into our own.

In addition, the Arabs knew how to get full value out of their ships. They were true scientists of the sea, experienced in navigation, meteorology and geography, adept at taking advantage of good sailing conditions on a regular seasonal schedule. Their dhows were not usually subjected to the oceanic battering that so often damaged the ships of less skillful navigators, those, for instance, who did not realize when the monsoon was about to change.

Da Gama's crew may have paled at the thought of sailing to India in a dhow, but Ahmad ibn Majid did not. He regaled his new acquaintances with sagas of the sea as the Arabs had