ARAMCO WORLD
505 PARK AVENUE, NEW YORK 22, N. Y.

THE RIYADH DAIRY

maintained. After every "run" from the vats, the system of pipes, vats, chiller and packaging machine is cleansed and disinfected. The floors of the processing rooms are flooded and mopped constantly.

Like any enterprising company, the National Dairy Plant is anxious to grow. There is sufficient floor space for expansion. But experience has taught the company to hedge slightly on the optimism of some of the store-owners who have a tendency to over-order during the hot months. Orders that increase suspiciously are trimmed at the plant.

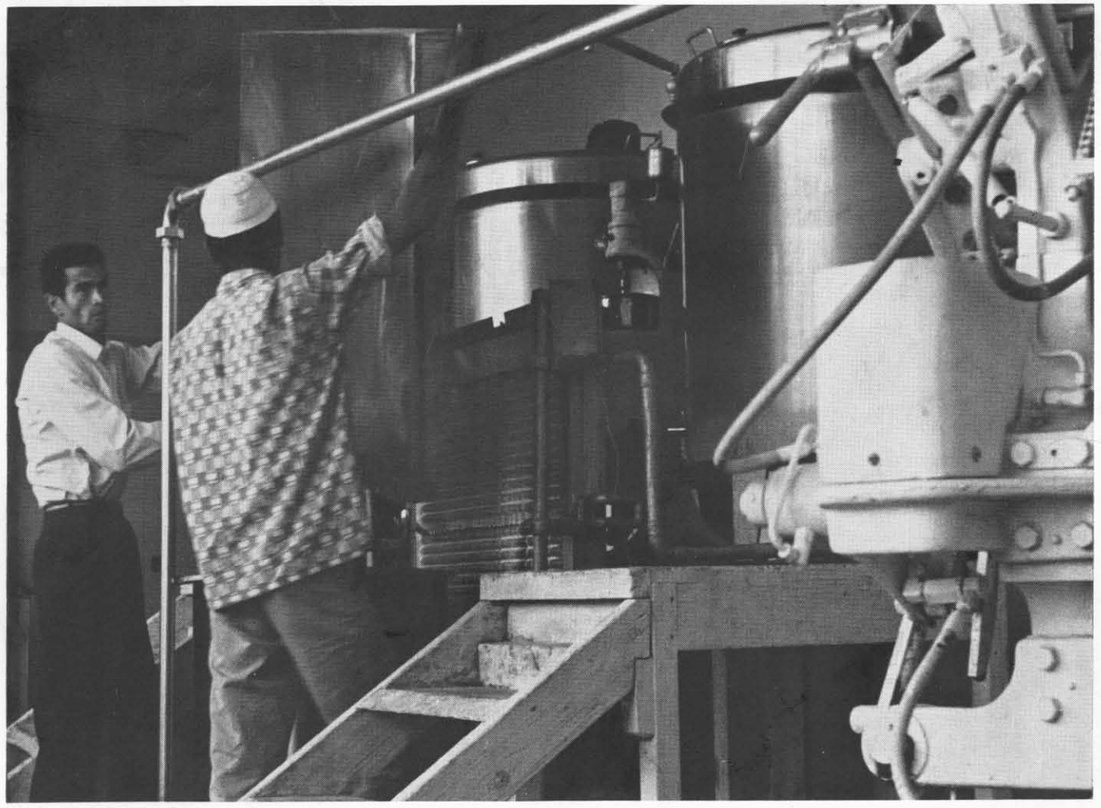
The company keeps close tabs on the sales in each store, and it has taught merchants the best way to store its *laban* for day-long freshness. In the past some store-owners used a traditional storage place – the roof of the store. The desert sun helped sales, but it hurt the product.

The company is proud of its product, and it has applied some of the know-how of the Saudi Arab *suqs* (bazaars) to the inscription on its cartons:

"SUPERIOR MILK – PASTEURIZED, REFINED, NOURISHING – Made by National Dairy Plant, Riyadh, Kingdom of Saudi Arabia."

Back in the shadows of the cool, dry storage room of the plant there is a small memento of the unpredictability of human taste: nearly 200 pounds of chocolate. The customer is always right. But a company that wants to grow has to take a chance sometimes. ■

By the time laban is on the way to merchants, employees are busy cleaning equipment in preparation for the next day's "run."



Aramco World
DECEMBER 1961

THE MODERN VALVE—AN OLD IDEA

Aramco World

DECEMBER 1961 VOLUME 12 NO. 10

FRONT COVER: These valves at the Aramco pump house in Ras Tanura, Saudi Arabia are direct descendants of valves designed 500 years ago by Leonardo da Vinci. Da Vinci's practical genius contributes every day to oil operations in Saudi Arabia and indeed wherever industry is at work.

PICTURE CREDITS: Front cover, Pages 8 (left), 14, 15—Aramco photos by T. F. Walters. Pages 3, 6 (left)—Culver Pictures, Inc. Page 4 (left)—Norwegian Information Service. Page 4 (right)—Australian News and Information Bureau. Page 5—A. Devaney, Inc. Pages 6 (right), 8 (right), 9 (left)—International Business Machine Corporation. Page 7—Aramco photo by V. K. Antony. Page 9 (right)—Aramco photo. Page 11—The Bettmann Archive. Page 12—The New York Public Library. Page 13—Jordan Mission to the United Nations. Pages 16, 17—Wide World Photos, Inc. Pages 18, 19, 20—Aramco photos by B. H. Moody.

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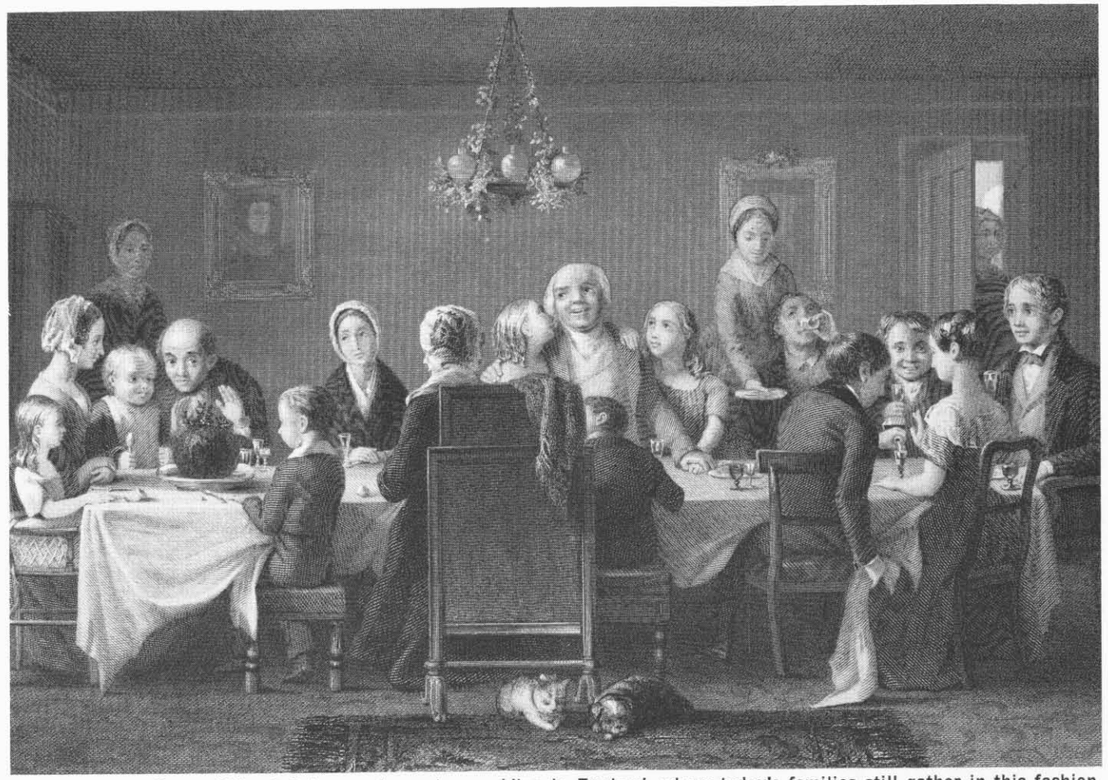


Christmas calls for traditional dishes, such as plum pudding in England, where today's families still gather in this fashion.

Around the Christmas Board

A Yuletide menu is as good as a map in identifying countries

CHRISTMAS EVE. Into the scrubbed and shining Anderson kitchen, looped with green garlands, march Father, Mother, Grandmother, Birgit and Arthur. They form a laughing circle around the stove and its steaming copper pot of meat broth. Each person in turn takes a piece of dark bread on a fork, dips it into the broth, spears a piece of meat or sausage and eats it. Mrs. Anderson checks her main dish for supper: dried cod, white and fluffy, with cream sauce and boiled potatoes. Where do the Andersons live? For anyone who knows Christmas foods, the answer is easy: in Sweden.

Past midnight, at the beginning of Christmas Day, Mr. and Mrs. Daval return to their apartment, soon buzzing with greetings and conversation of relatives and friends. Midnight Mass was beautiful but lengthy; many guests walked from church in the frosty night air. Everyone is ravenous. The dining room is warm and waiting: oysters, truffled turkey, spicy pâté, hot crisp bread, chilled white wine. Where is this happy setting? Paris, of course – the start of a Réveillon supper.

A holiday menu is as good as a map to identify countries at Christmastime. "Tell me what you eat, and I will tell you what you are," said the great gastronome, Brillat-Savarin. He might very easily have added: "Tell me what foods you eat at Christmastime, and I will tell you where you live."

Feasting on holidays is a universal custom as old as the holidays themselves, but Christmas feasts are national, local, sometimes personal and always traditional. Christmas recipes are handed down from generation to generation, and whatever these Christmas dishes may be, they hold extra savor; they have been written about, sung about,

talked about; they are part of national heritages.

Christmas food need not be logical. In Iceland the Christmas dish is smoked lamb or mutton, though many modern farms include deep freezers. People could eat fresh lamb if they chose, but they prefer the smoked variety, because it had been the family Christmas meal through centuries when meat had to be cured for the long winters.

One meal of all the holiday meals stands out – the meal which brings family and friends together. According to the country, it may be early supper on Christmas Eve, a gay repast after midnight Mass, or dinner on Christmas Day.

In many European countries, it is Christmas Eve supper, and fish is the main dish, either because December 24 is a Catholic fast day, or by tradition.

Carp, cooked in various ways, is a Christmas favorite in Austria and Germany. In Vienna the carp are fattened in crates anchored in the Danube, then breaded and fried; in Berlin it is served with creamy horseradish sauce, and scales are left on the fish so that each guest can take a single scale as a good-luck charm for the year to come.

Hungarians season their Christmas Eve fresh-water fish with paprika, serve it with potato puree and poppy-seed or nut noodles. In Poland the first star of Christmas Eve signals time for supper, and the main dish may be carp with dark raisin sauce or pike with saffron. Eels are the Christmas Eve fish throughout Italy and Sicily, especially in Naples, where market streets are closed to traffic on December 24 and the whole city turns out gaily to choose a supper from hundreds of eel-stalls.

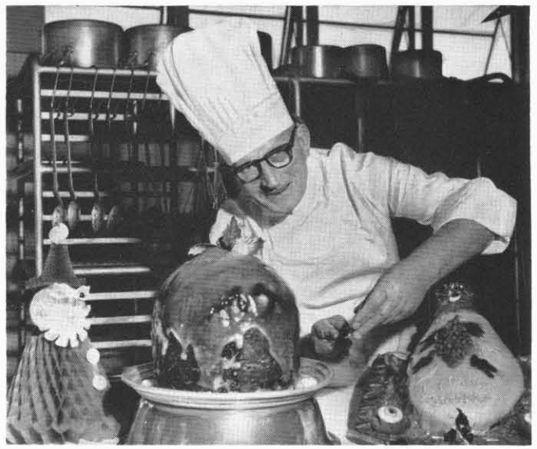
Three weeks of soaking, buried in ashes, cleaning and boiling turn dried cod into *lutefisk,* the Christmas Eve dish of Norway and Sweden. A Scandinavian hostess sets a *yulebord* or *smörgasbord,* tables laden with delicious hot and cold meats, salads and sweets, but *lutefisk,* in its final white and fluffy state, holds the place of honor.

Before the feast, as noted at the Andersons' home, the family must gather in the kitchen for the traditional good-luck ceremony, "Dipping into the kettle" of broth in which the meats were cooked.

The Danes prefer a juicy roast goose, stuffed with dried apples and prunes, to their neighbors' *lutefisk,* but they join Norway and Sweden in always serving a Christmas rice pudding or porridge – rice slow-baked with milk and sugar, dusted with cinnamon and garnished with a pat of butter. What sets this Christmas *risengrod* apart from everyday rice pudding is the single almond baked inside. Whoever finds the almond will be lucky all year and may get an extra gift.

To be sure of good fortune it is advisable, in all three countries, to set out a dish of rice pudding – with plenty of butter – for the *Jule-nisse,* the Christmas gnome who lives in barn or attic and brings the family good or bad luck, according to his temper. No one ever catches sight of this grey-bearded, red-capped creature (except on Christmas cards), but on Christmas morning the pudding is gone!

The Christmas Eve "smorgasbord" of Norway and Sweden features "lutefisk" set off by meat dishes, sweets and salads.



Australian chef preparing English plum pudding proves that Yule dishes were not left behind when new lands were settled.

A cup of soup or a sandwich is Christmas Eve supper enough when midnight Mass and a Réveillon feast are to follow, as in France and Belgium. Fashionable city restaurants offer their most elaborate meals of the year. In Paris the menu is sure to include oysters, pâté de foie gras, sausages, galatines and roast duck or turkey breathing the perfume of truffles placed under the skin. The French Christmas cake is the "bûche de Noël," shaped like a small Yule log, with mocha frosting imitating a knotty bark.

Cities and provinces cherish their own Réveillon specialties. Brittany relishes buckwheat cakes and sour cream. Burgundians prefer turkey and chestnuts, while the people of Provence like snails and mullets, with eleven kinds of fruits, nuts and sweets for dessert. Across the sea in Canada, families of French descent serve two New World dishes – pig's knuckles and meat pies.

In Mexico, after midnight "Mass of the Cock" (so-called because it once took place at cock-crow), supper is sure to include the "Noche Buena" or Christmas Eve salad of many ingredients, including fruits, nuts and cheese; sweet tamales; and *buñuelos,* circles of yeast dough fried in deep fat and served with syrup.

"Christmas Eve is not the night to sleep," goes a Spanish saying, joyously obeyed in Spain and Latin America, where after-midnight-Mass celebrating goes on until dawn. People dance and sing in brightly lighted streets; toys, fruits and candy are on sale in the markets. When eventually a Spanish family sits down to eat, the main dish may be turkey, goose or *puchero,* a stew of chicken, beef, pig's feet, bacon and garlic.

In spite of South American sunshine and blooming flowers at Christmas, roast turkey may be the main dish. Argentina and Colombia choose roast suckling pig, often cooked outdoors, barbecue-style. The Christmas dish of Venezuela is *hallacas,* little pies about the size of turnovers, the cornmeal crust filled with chopped meat, olives, nuts and raisins, wrapped in banana leaves and steamed for several hours. Venezuelan cooks make *hallacas* by the dozens at holiday time.

Dinner on Christmas Day, after a morning church service, is the English tradition, followed in Canada and the United States. Colonial Americans and Canadian settlers adopted English dishes such as plum puddings and mince pie. Goose, only one of many courses at sixteenth-century banquet tables, has kept high place as England's Christmas dinner but shares honors with traditional roast beef and turkey. The bird Charles Dickens immortalized in "A Christmas Carol" was, of course, a brown and savory goose, gushing sage and onion stuffing.

Queen's College, Oxford, keeps an even older tradition: the ceremonial serving of a boar's head, a custom dating back to medieval times when wild boars were hunted. The twentieth-century boar's head, decorated as of old with bay and rosemary, is carried to the college table with great pomp to the singing of the ancient carol:

> The boar's head in hand bear I,
> Bedeck'd with bays and rosemary;
> And I pray you, my masters, be merry.

The American Christmas dinner needs no description. From White House to roadside diner, chefs and housewives carve the golden turkey, surround him with creamy mashed potatoes, candied sweet potatoes, and cranberry sauce.

On a map of Christmas foods tiny oases of contrast stand out, made by people who are eating Christmas dinners unlike meals around them. Travelers, families stationed abroad, new citizens remembering customs of their mother country – all try to serve the Christmas foods which taste of home. Venezuelans studying or working in the United States grow nostalgic for *hallacas* at Christmas: no turkey can take the place of those meat pies. Americans abroad must have turkey for dinner, if it's to be a real Christmas. So Christmas foods go round the world by plane or ship, bound for hungry exiles.

Most people like to experiment, to try new things to eat, but when Christmas comes, wherever they are, the holiday meal must be the familiar dishes – foods which hold an extra flavor – Christmas foods. ■

American Christmases wouldn't be the same without turkey and trimmings. Who gets the legs is always a big question.

It is no exaggeration to say that wherever a wheel of industry turns, Leonardo da Vinci's guiding hand is behind it

Down-to-Earth Genius

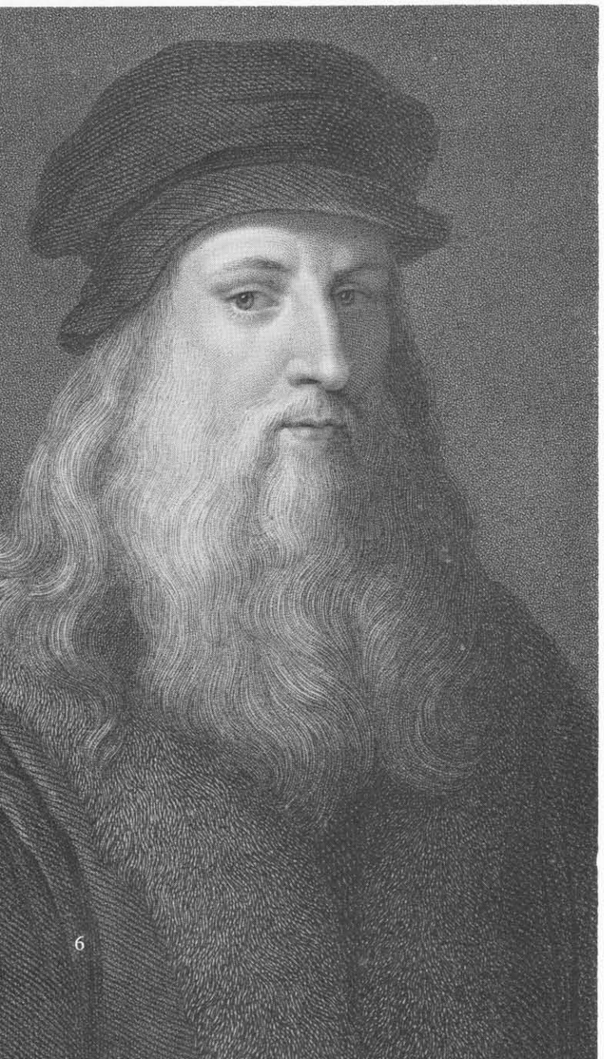
THE MEN and machines that moved across the broad oilfields of Saudi Arabia to produce hundreds of millions of barrels of crude oil in 1961 drew on a vast store of technological knowledge. Much of this know-how stems from mechanical concepts that were created over four centuries ago by Leonardo da Vinci, 2,000 miles from the oilfields. Every day, in almost countless applications, the scientific principles of the Italian genius find practical expression in Aramco's oil operations.

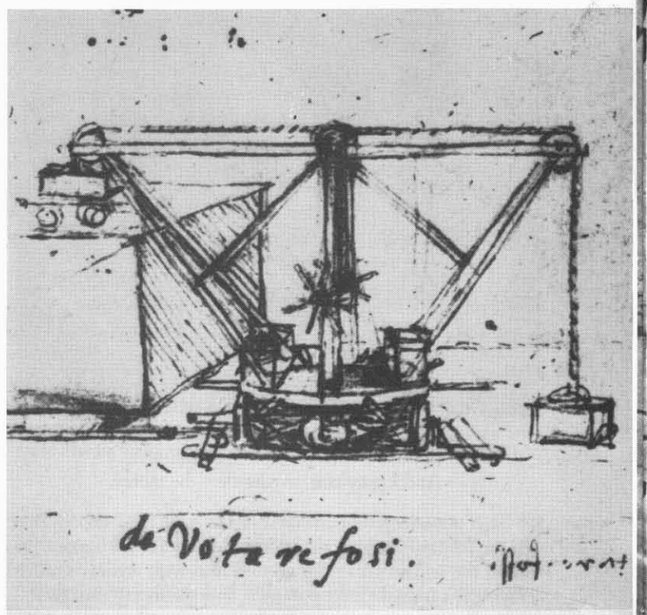
In the realm of mechanical science, da Vinci was a solitary worker hundreds of years ahead of his time. Born in 1452 in the sleepy village of Vinci, which nestles in the Italian hills halfway between Florence and Pisa, he remains to this day unmatched for his unified genius in art and science. More than an artist who left a permanent record on canvas of the faces of contemporary monarchs and celebrities, da Vinci set down in black and white scientific principles that have come down to 1961 unaltered. His theory of hydraulics, roller bearings and gears, for example, has never been improved upon. He devised the principles of hoists, cranes, pulleys, meters and steam pressure. The flying spindle, the lens grinder, the coin stamper, the diving belt, the self-propelled ship, the light projector and even air conditioning and the revolving stage are products of his imagination.

Aramco's oil operations in Saudi Arabia are an excellent example of the oft-quoted statement that wherever a wheel of industry turns da Vinci's guiding hand is behind it. The numerous pipeline valves at Ras Tanura that permit the flow of oil to waiting tankers and indeed every valve in the ingenious network of oil pipelines in Aramco's gathering system and along the 1,068-mile Tapline that carries oil to the Mediterranean harks back to da Vinci's original concept — a concept that proved simple but indispensable.

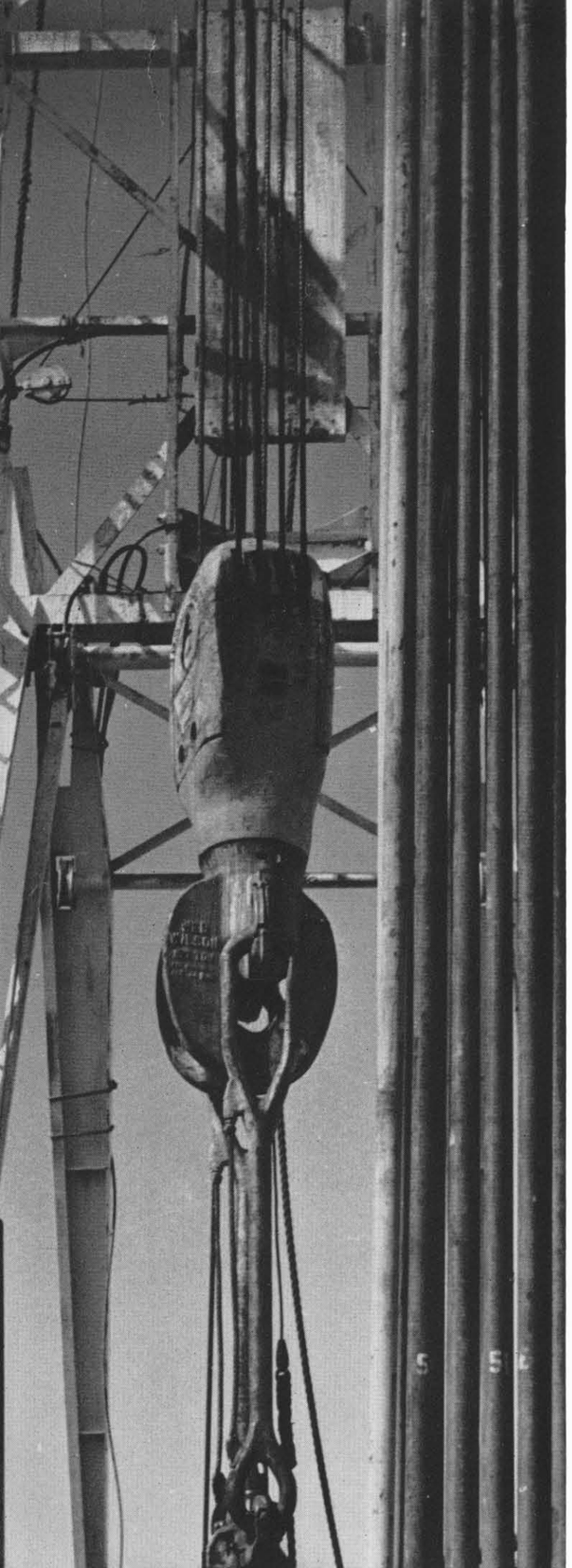
Aramco's DC-3s that fly the long supply route along the Tapline and the sturdy Beavers that serve as aerial messengers for seismic exploration parties in the Rub'al-Khali are descendants of da Vinci's flying machine. Da Vinci was more than passively interested in flying. He nearly dashed himself to death experimenting with his batlike contraption, which later scientists claimed would have flown had it been equipped with a proper motor. After a close call, da Vinci, who foresaw the hazards of the day when men would wing far above the earth, devised as a safety measure the first parachute. With a pyramid-shaped umbrella made of linen, he plunged off the top of the Leaning Tower of Pisa one summer afternoon and landed safely on his feet eight stories below.

The scope and versatility of da Vinci's mind is immediately evident in two of his apparently incongruous creations: the "Mona Lisa" painting and the hydraulic jack. The delicate portrait with the haunting, enigmatic smile came from the same inspired hand that drew working plans for a jack capable of prodigious feats of strength. Each time an Aramco 400-ton drilling rig is moved to a new location, da Vinci's hydraulic jack supplies lifting power. And when the rig is ready to roll across the desert, its progress is aided





Today it is no surprise to see huge cranes at work, such as this Aramco crane (right) aiding construction of a water injection system near Dhahran, Saudi Arabia. But many of the ideas embodied in such equipment are 500 years old. Because of da Vinci's active involvement in engineering and architectural projects, especially canals and military fortifications, he designed numerous machines to speed up the work, including a double-armed crane (above), hydraulically-operated saws, canal excavators and other earth-moving devices.



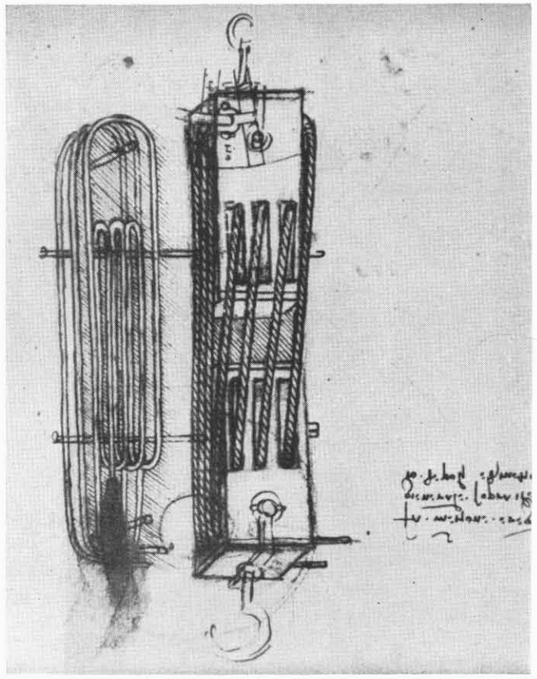
DOWN-TO-EARTH GENIUS

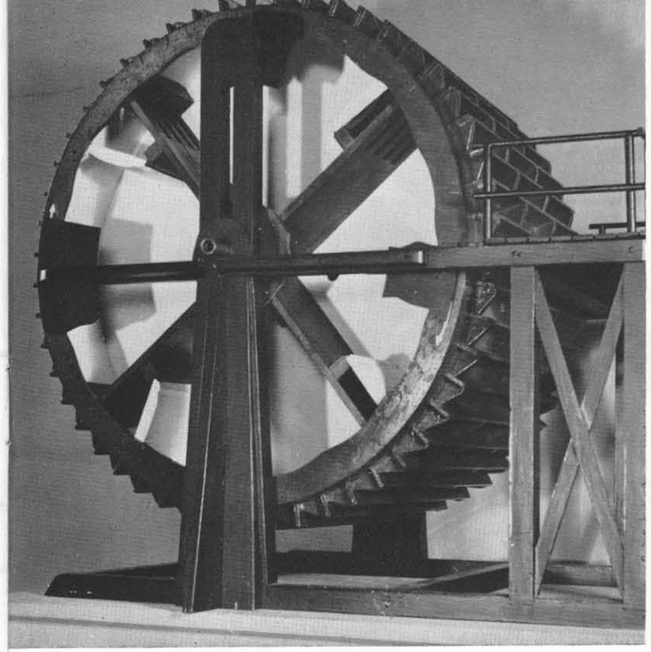
by friction-reducing roller bearings that are by-products of da Vinci's studies of motion. Once the drilling rig is in place over oil-bearing strata, da Vinci's concepts again are employed. As the driller raises or lowers a rotary hook, da Vinci's circular pulley is called into play, and whenever a heavy load needs a lift, a modern application of his pivoting crane does the job.

There seems no end to his industrial contributions. When the oil flows from each of Aramco's wells, the volume is clocked by measuring devices that stem from da Vinci's concepts. Aramco power plants depend to a great degree on his principle of the hydraulic screw that converts potential energy into motion. Refinery boilers, such as those in use at Dhahran, were foreshadowed by da Vinci's steam gun, based on pressure released from heated water. The flow of oil in and out of the refinery is regulated by technicians who rely on refinements of da Vinci's variable speed drive apparatus. When the Aramco employees go home, their air conditioning units have da Vinci's water wheel device as an ancestor.

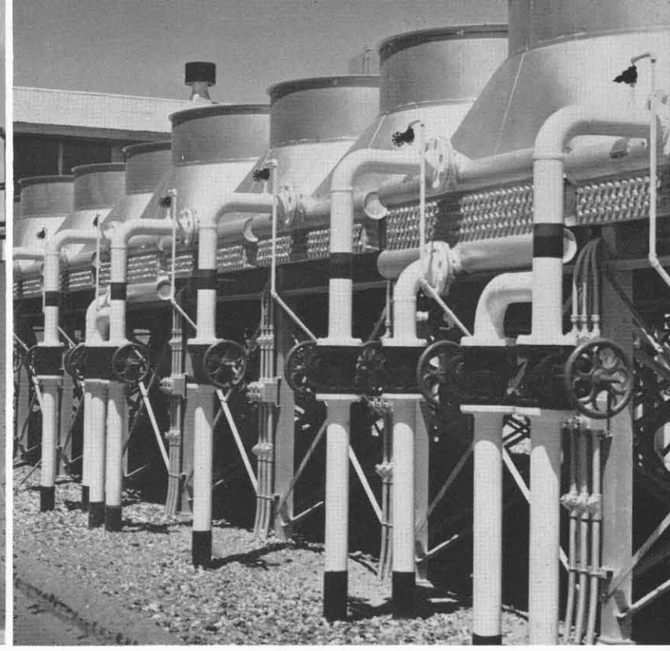
Of course, not all of the Italian genius' achievements apply to Aramco's oil operations. His sketches dealing with anatomy, biology, meteorology and geology spearheaded later studies in those branches of science. As an engineer, da Vinci built a two-way canal that set the standard for modern artificial waterways such as those at Suez and Panama. He also designed numerous fortifications and even

Traveling block and hook of Aramco structure drilling rig at left is a refinement of a da Vinci multiple pulley as shown below in inventor's original sketch. Traveling block and hook support the string of drill pipe suspended in the well hole.





Da Vinci invented air conditioner for wife of patron, Duke of Milan. One-story-high wheel, turned by water power, drew air into drum, cleaned and cooled it, and piped it into room.



In Saudi Arabia da Vinci's air-conditioning principles find welcome employment against the desert sun. Blocks of fans are part of the cooling system of Tapline pump house at Rafha.

blueprinted the aerial bomb, machine gun and military tank. As an architect, he completed the long-dormant plans to finish the hundred-spired Cathedral of Milan. It is small wonder, then, that later ages, and especially this age of specialization, tend to think of Leonardo da Vinci as the "universal genius."

His birthplace was almost within earshot of the bells of Florence. The iron-fisted Cosimo di Medici, who reigned there, found enough time between his intrigues and wars to sponsor young, promising artists. Talent abounded and mediocrity was unpardonable. It was a time when something wondrous was in the air. Fabulous tales – some true, some false – were trickling into Italian salons concerning exotic lands beyond the sea. Into this cultural climate Leonardo was born.

When he was still a boy, Leonardo exhibited a flair for drawing, and his father, a successful lawyer, entrusted the child to Andrea Verrocchio, an artist and family friend. At the Verrocchio studio Leonardo mastered the rudiments of art almost overnight. One day the young prodigy painted a cherub into one of his teacher's unfinished paintings. So perfect was the angelic likeness that Verrocchio confessed that there was nothing more he could teach da Vinci.

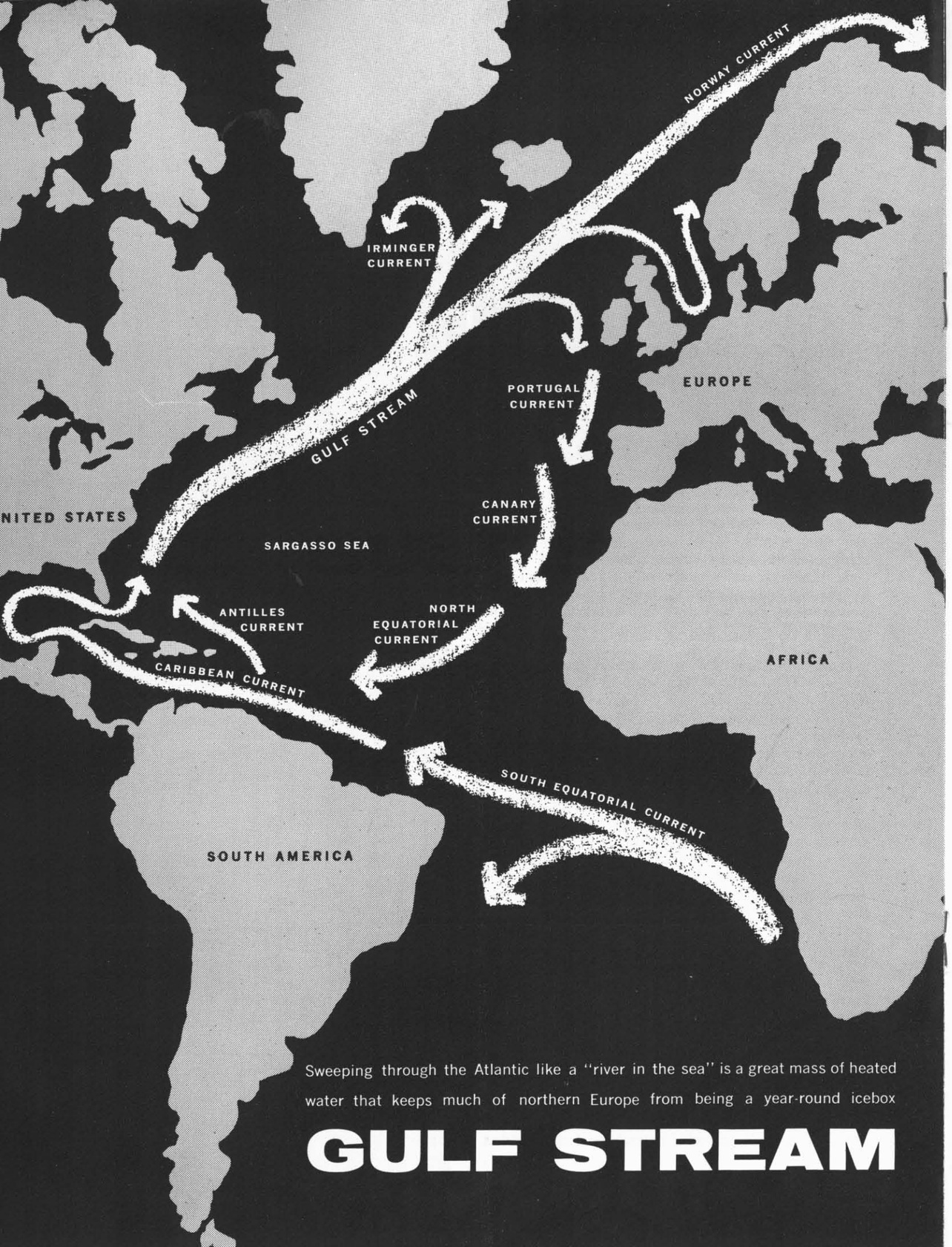
Lorenzo the Magnificent, grandson of Cosimo di Medici, took a liking to the aspiring artist. As a favorite of the Florentine court, Leonardo's career was assured, but a chronic restlessness goaded him on to Milan, where he enlisted the patronage of Duke Lodovico Sforza. The Duke, who had just seized power in Milan, ordered a slum clearance project to gain popular support. Da Vinci was commissioned to draft plans for this project and several other municipal improvements.

The most prolific period in Leonardo's life was spent in Milan. For ten years he worked tirelessly producing sketches, paintings and treatises on mathematics and physics. When history caught up with Duke Sforza and left him to die in a cell in France, da Vinci went to Venice, where Cesare Borgia kept him busy laying out fortifications. After his father's death, Cesare tumbled from grace, leaving Leonardo without financial backing.

Returning to Florence, da Vinci entered a painting competition with his archrival, Michelangelo. Both artists were to commemorate a victory of the Florentines over the Pisans. Da Vinci chose to paint the battle of Anghiari with realistic detail. In a surprise move, Michelangelo portrayed a lull in the battle when the Florentine soldiers, while bathing in the Arno River, were about to be ambushed by the Pisans. According to contemporary reports (neither of the original murals remains), the two murals outdid each other. The superb masterpieces were acclaimed "two wonders of the world" by judges.

Rome was next for the wandering genius. His younger contemporaries were all at work on important commissions. Michelangelo, for example, was flat on his back atop a huge scaffolding, starting to paint the ceiling of the Sistine Chapel. Raphael was busy designing frescoes. Only the 60-year-old da Vinci lacked work. Then came an offer from Francis I, King of France, to relocate at the King's summer palace at Amboise. Starting a new life in a strange land was not easy for the aging Leonardo. A stroke paralyzed his right side. Fortunately he was left-handed, and the handicap did not interfere with his work output, most of which was in his renewed interest in hydraulics and mechanics.

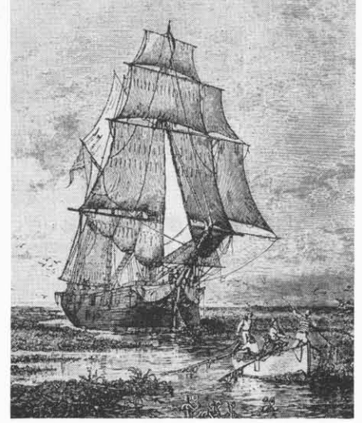
Leonardo died in 1519, more than four centuries ago. But it is impossible to consign his greatness to the realm of dusty history. For today, even as in his own time, his concepts and inventions are as essential as ever and find everyday expression wherever men and machines are at work. ■



Sweeping through the Atlantic like a "river in the sea" is a great mass of heated water that keeps much of northern Europe from being a year-round icebox

GULF STREAM

Only a small part of the Gulf Stream current originates in the Gulf of Mexico. By the time the Caribbean Current flows into the Gulf and squeezes out into the Atlantic between Florida and Cuba, its waters have been swelled by the vast circular bundle of Atlantic currents that embrace the placid Sargasso Sea. Important factors in driving the various currents along are the permanent wind systems: the currents' clockwise flow is maintained by trade winds from the northeast blowing across the southern part and prevailing westerlies across the northern part.



Mariners of sailing-ship days feared the Gulf Stream's "eye"—the Sargasso Sea—for its lack of wind and miring seaweed.

GULF STREAM — the very name fires the imagination. Half forgotten stories come alive again with its mention, tales of tropic skys, trade winds and flying fish, and voyages of discovery by Columbus and Amerigo Vespucci. There the dark careers of Morgan and Blackbeard were played out; there, along the great curve of the stream, swept the haughty Spanish galleons with straining sails and holds crammed with gold bars, rubies and silver chalices. Indeed, so rich in fact and fancy is the Gulf Stream that story-tellers risk becoming becalmed in some fascinating corner, much like the ships of legend that wandered into the stream's Sargasso Sea and there lay trapped forever in a never-never-land of tepid water and amber seaweed.

Where the Gulf Stream's story begins, no one knows. Scientists speculate that perhaps during the earth's Tertiary Period, 60 million years ago in the time of giant reptiles and birds, the Gulf Stream was being formed and urged onward by the earth's natural rotations. Out of the Bay of Yucatan and through the Straits of Florida water heated at the Equator rushed north until its volume far surpassed the water poured into the oceans by all the great rivers of the world combined. In fact, the *one hundred thousand million tons* of warm water that flows through the Straits of Florida into the Atlantic *every hour* is more than 20 times greater than all the fresh water entering the oceans from all the rivers, all the rain clouds and all the thawing Arctic and Antarctic glaciers. Research indicates that in some places the Gulf Stream's current reaches a depth of one mile and a speed of four miles an hour. No wonder that scientists often refer to this "river in the sea" as the mightiest of rivers.

As it swept northward across the Atlantic in the earth's ancient days, the mass of heated water began to warm all the land that it washed against and even more distant lands touched not by its waters but only by the winds that blew across the current. Climates changed and lands once locked in the grip of eternal winter turned green. By the time that latecomer, man, arrived on the scene, these lands offered favorable climates for his first crude endeavors.

The enormous volume of heated water carried by the Gulf Stream to Europe provides an additional 8 to 15 degrees of warmth over the temperatures that would prevail if the current did not exist. Those few degrees make a crucial difference. They are the reason that Iceland is habitable, that Ireland and the United Kingdom are green. They give Norway ice-free harbors and fjords and make Murmansk the Soviet Union's only wintertime, ice-free port. Leningrad, much further south than Murmansk, is frozen up all winter, because it is not washed, like Murmansk, by the stream's warm waters. Those 8 to 15 degrees are, in short, the reason why much of North Europe enjoys a temperate climate. Other areas of the world at the same latitudes as North Europe (Siberia, for example) but without a Gulf Stream are lands of long, cruel winters.

The Gulf Stream is more than North Europe's central heating system and a highway between the New and Old Worlds. It is a vast cupboard that has fed men for a thousand years, ever since the hardy Norsemen sailed westward in search of fish. Swept along throughout the Atlantic by the Gulf Stream is a teeming, living tide of sea-life called "plankton" on which almost every fish feeds. The flow of food attracts and breeds great schools of fish, especially cod, tuna and herring. Today, just as in the past, the plankton of the Gulf Stream's water gathers and feeds the schools of the New England and Newfoundland coasts, as well as the schools that abound off European shores.

This ocean current that has played such a large part in man's affairs is actually not a single current at all. It is more like a great *circular* river composed of a bundle of intertwining rivers and currents. Oceanographers are not anxious to state where the stream begins, for the problem is something like trying to state where a circle begins. When the Gulf Stream is dissected, however, it might be said to begin off the coast of Portugal, where water starts to move from Europe to America.

Down the western shores of Europe and around the bulge of Africa the current flows, then westward at the Equator to South America. The onrushing waters turn north and split into many strands. Here, in the bay of Yucatan, is the true caldron of the Gulf Stream, where the water is actually given the heat that will be discharged into lands thousands of miles away to the northeast. Here also, desperate men like Morgan and Blackbeard flew the "skull and crossbones" from swift ships. When the strands reunite at a point off Cape Hatteras on the North Carolina coast, the current takes on its familiar name – the Gulf Stream. Off the Newfoundland banks, in iceberg-strewn waters that claimed the *Titanic* in 1912, the Gulf Stream splits again. The northeast arm is the real heating system of North Europe, warming areas all the way to Murmansk, 155 miles north of the Arctic Circle. Ireland and the United Kingdom

are washed by the current's warmth. Then the beneficial waters sweep south to the coast of Portugal, thus completing their circular course.

In the center of the circle is the Sargasso Sea, a gently rotating spiral kept eternally in motion by the encompassing Gulf Stream currents. Named by the Portuguese for its abundance of *sargaço* (seaweed), this part of the Atlantic, as large in area as the United States, is one vast garden of golden seaweed. So thick in places is the seaweed that it takes little stretch of imagination to believe, along with old-time sailors, that a ship might become mired in the seaweed to drift and rot at the whim of the Gulf Stream.

Most of what is known about the Gulf Stream is of recent origin, but a force as great as the Gulf Stream's system of currents could hardly go unnoticed once men began taking to the sea. There is some evidence that as early as 530 B.C. a Carthaginian admiral named Hanno made a voyage along the Atlantic coast of Africa and there noted the strong current later known as the Guinea Stream. The Phoenicians, in their voyages out to the Canary and Azores Islands, certainly must have noted the swift currents. Later and far to the north, Vikings such as Leif Ericson fought the Norway Current to reach the New World. In 1341 the Canaries were rediscovered by the Portuguese, possibly after the Normans and Arabs had visited them. All would have had to face arms of the Gulf Stream.

When Continental Congress sent Benjamin Franklin to France in 1776 to negotiate a treaty, the statesman-scientist began his studies of the Atlantic current he named "Gulf Stream."

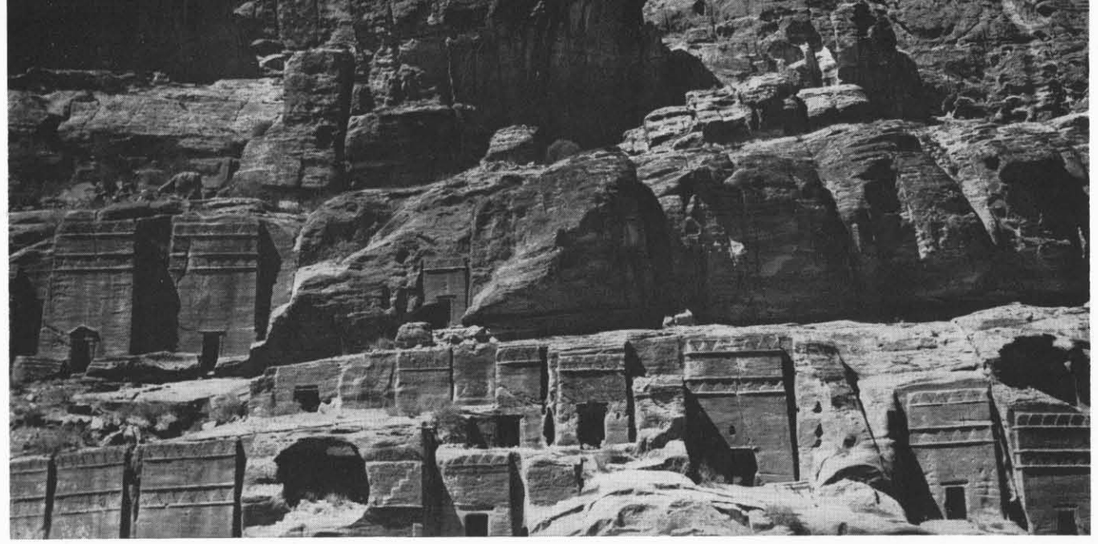
One hundred and fifty years later, on September 13, 1492 a weaver's son from Genoa made a notation in his log that stands as the first written account of a strong North Atlantic current. "We saw a broken mast, roughly the size as those of the *Pinta*, drift past us. It drifted faster than our ship, and we lost sight of it . . .," wrote Christopher Columbus. Soon the Spanish explorers and conquistadores who followed Columbus found that they could return to the Old World with greater speed if they came up from Havana past the long, unknown coast of Florida and kept out of the seas south of the Bahamas. Then, almost on the French coast, they would turn south and sweep home to Spain and Portugal riding the Gulf Stream with a speed that elsewhere would have required driving winds.

From then on the Gulf Stream was traversed by names rich in history and legend: Cabot, Cortez and Pizarro, Amerigo Vespucci, who would lend his name to the New World, Drake, Hawkins, Hudson and Raleigh. Not all of them would fill their logs with the peculiarities of the Gulf Stream, for the mighty current more than once has escaped human scrutiny. Even as late as 1602, for example, one Bartholomew Gosnold sailed against the current from Europe to America and was perplexed at the length of time it took; then his voyage took him home in the opposite direction, and he was overjoyed with the ship's speed. He saw the Gulf Stream's seaweed and described the trip as a "most remarkable, but inexplicable thing, to explain whose cause would require a great deal of delicate ingenuity."

Benjamin Franklin, that first American scientist of note, was fascinated all of his life by the strange flow of warm salt water sweeping northeast along the American coast. Franklin sailed to Europe in 1776, during the American Revolution. While British captains in warships scoured the North Atlantic, ready to hang American "traitors," Franklin applied a scientist's eye to the ocean. Every day he made notes on water temperatures and the speeds of the wind, current and ship. On his way home eight years later, the famous American, old and ill at that, again took up his studies of the stream. He lowered buckets and thermometers into the green, tranquil sea at the surface and many fathoms deep. When his ship crossed the western edge of the current, he carefully recorded the sudden coldness of the water, its change in color and the lack of floating seaweed. In 1786, after poring over the records of many other ships, Franklin reported on the strong current before a meeting of the American Philosophical Society in Philadelphia. At that meeting Franklin gave the current a name – the Gulf Stream – and suggested that all nations cooperate in the exploration of sea currents. Although he was mistaken in thinking that the stream flowed from the Gulf of Mexico, the name was not entirely inappropriate, for "golfo" was the term used by Spanish sailors in the West Indies to refer to the sea, and they were among the first to be intimately concerned with the Gulf Stream.

After Franklin awakened the scientific interest in the Gulf Stream, men of many nations set out to unlock the current's secrets. In 1800 the German oceanographer Alexander von Humboldt sailed 25,000 miles through Gulf Stream waters and reported on the variability of the currents depending on the seasons and the winds. Von Humboldt estimated that it took about two years and ten months for the water to make a complete circuit. The English geographer James Rennell and the American navigator Matthew Maury took up where von Humboldt left off. From then on hardly a year passed without new knowledge coming to light under the direction of men such as Chapin, Ekmann, Hansen, Munk, Rossby, Stommel, Iselin and Wüst. Today, oceanography institutes of many nations are applying the latest equipment – airplanes and blimps, radar and loran, specially fitted ships, both surface and submarine – to add to the studies that Benjamin Franklin first outlined.

A recent expedition proved that the Gulf Stream has a pulse. The heated water flows in successive thrusts, pulsing like the blood in an artery. And like an artery the Gulf Stream is a sustainer of life. As a highway of commerce and even more as a giver of warmth and food, the Gulf Stream's massive current has flowed inextricably through the history of Europe and America. ■



THE CITY CARVED FROM STONE

In its high, rock-bound valley, rose-hued Petra served as host to caravans from East and West

Petrean homes, one to six rooms, were cut into red cliffs and joined by flights of rock stairs.

STANDING on the roof of his stone palace, Aretas IV, king of Arabia Petraea, surveyed the twilight beauty of a spring night. Craggy sandstone peaks circled the valley except to the north, where the rounded slopes of Ayun Aghrayeh shone like beryl against the pale gold sky. Here, half way between Gaza and the Gulf of Akaba, not far from the Mediterranean, rested the city of Petra, almost 2,000 years ago.

Aretas' kingdom ran south from Damascus, 600 miles to the shores of the Red Sea, but it was in this central mountain fastness, the rock-carved city of Petra, that he had his capital and felt most at home. He stepped to the edge of the roof and peered into the bustling street.

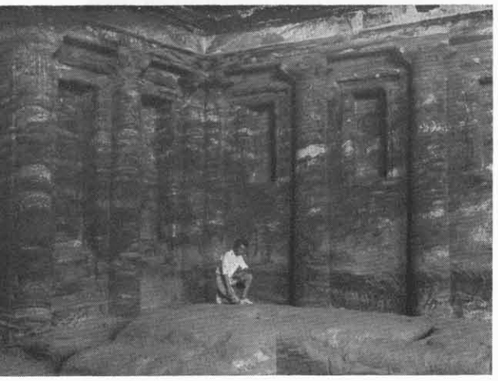
"Forty-eight years," he murmured, "have I ruled in Petra in peace and prosperity and been known as *'Rahem-anneh,'* lover of the people. Never have we been threatened as Tiberius' legions threaten us now!"

The city below him occupied a circular valley some two miles wide and 2,800 feet above the sea. Through its center, from east to west, flowed Wady Moussa, a river that was said to have had its source in the spring created at the touch of Moses' rod. Other streams joined it, and a paved street ran along each side of the walled channel. The palace, a temple and the market place rose on the south bank. Beyond the city lay the little fields, the baked clay cottages and reed huts of the poor. But the real glory of Petra – temples, tombs, warehouses, dwelling places and workshops – stood aloof in the surrounding crags, carved from the dull rose and russet face of the living stone.

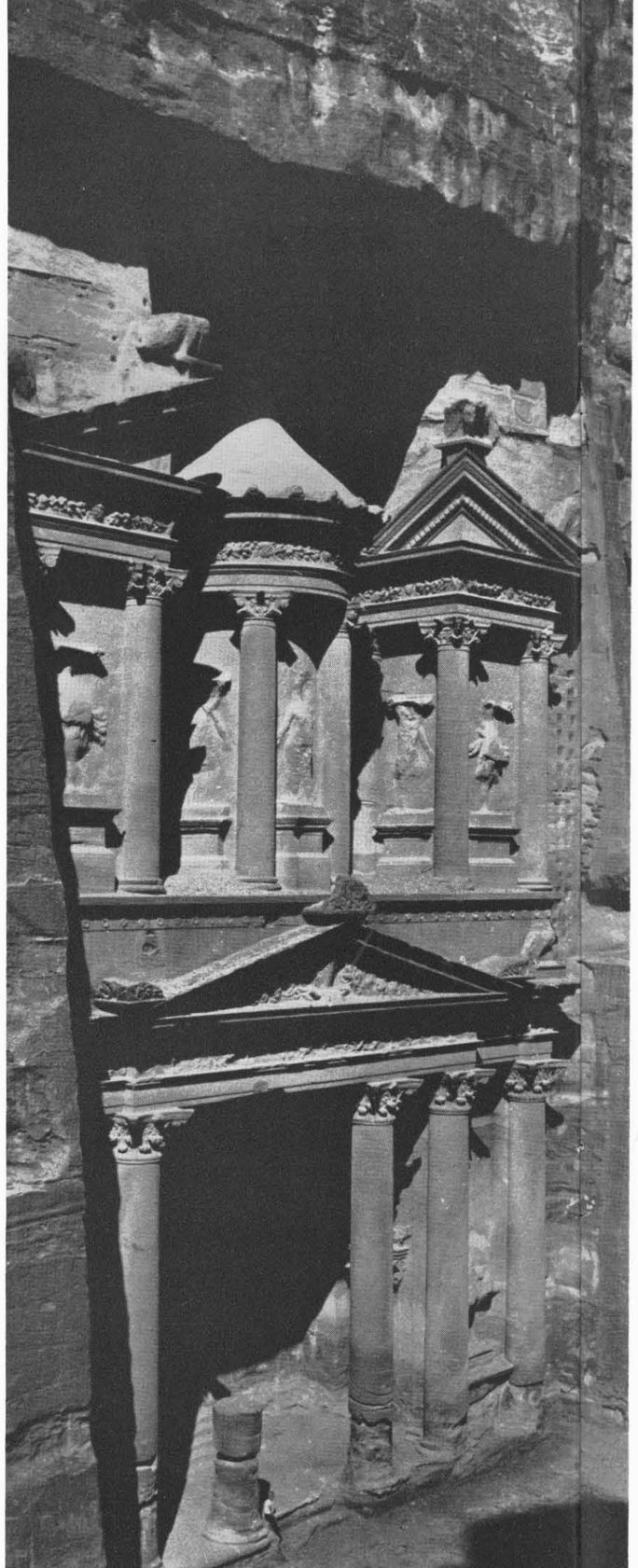
Aretas stepped back to the center of the roof and examined the beaten gold altar he had reared to the god, Dusares, to make sure everything was in order for evening prayer. In his mind he visited every corner of his city. Now he was among the multi-colored cliffs, and everywhere rose up carved facades and columned doorways with spacious chambers behind them. Some of the carvings were Grecian and others showed the savage strength of Assyria. He saw the Nubian guard lounging on the steps of the Khazneh, a temple treasure house exquisitely wrought in tapestry colors, crimson and indigo, veined with blue, yellow and white. He heard the hum of turning wheels and many voices from the low, gray caves of the potters, weavers and metal-workers. Here, close to the narrow entrance gorge called the Syk, the masons were just leaving the unfinished arc of the new amphitheatre that would seat a full tenth of Petra's 30,000 citizens when it was completed. Higher up stood the Ridge of Obelisks, the row of squared black stones sacred to Dusares, who would allow no graven images to be worshipped in his name. And along the windy ledges of the High Place, little groups were straggling toward the altar for prayer.

It was the supper hour, and the clamor in the street had died away except for the occasional snort of a camel or the strange babble of foreign voices from some newly-arrived caravan. Aretas' nostrils had long been plagued with the odor of camel dung fires, frying lamb fat and sesame oil, but now he caught the delicate scent of white broom. It made him wish he could stray along the watercourses as he had done in his boyhood, gather pink oleander and dwarf iris, and shake down the figs from the little wild trees that grew in the stony hills. He wanted to make friends again with peacock-colored lizards, tame gazelle and ibis and watch the white Egyptian vultures swooping overhead. But he was an old man now and a king, and rumor had it that Vitellius would soon march from Rome with two legions to attack his people. He must consult his advisers.

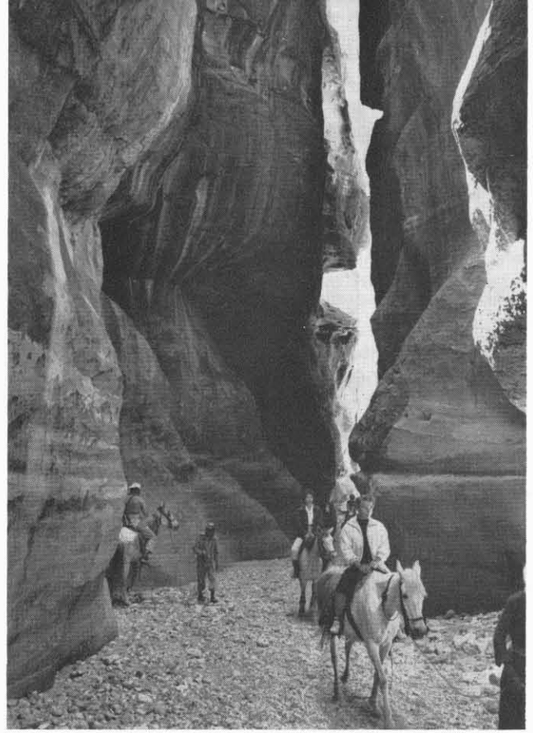
Petra had once belonged to the Kenites, children of Cain, iron-workers and tillers of the ground; then to the Horites



In 106 A.D. Petra came under Roman rule. The carved interior of a rock-cut "triclinium" or Festival Hall, seen through its wind-worn facade, contained a couch at which Petreans took their meals.



The Khazneh, a temple and treasury, was cut into the rosiest of all of Petra's cliffs. More than 90 feet tall, it is the best preserved building in a city that was deserted a thousand years ago.



The camel caravans of the past came to Petra from Gaza to the west and Bosra and Damascus to the north, entering through the Syk, a winding gorge that modern travelers still follow to visit Petra.

THE CITY CARVED FROM STONE

and the Edomites. But Aretas was a Nabatean, and his people, a Semitic tribe, had come up from Babylon in the fourth century B.C. and begun the wonderful stone carvings that gave the city its name. They wrote in Aramaic and spoke a dialect of Aramaic and Arabic. They were skilled in astronomy, medicine and magic, and had a great reputation for wisdom, but they soon grew to be master merchants in the caravan trade.

The high, rock-bound valley had always been used as a refuge when men went to wars or far-off trading fairs. Women and children, treasures of gold, silver, silks and spices could be safely hidden behind its crags. And as trade increased, the great caravans made it their favorite stopping place, since they could always find safety and fresh water there. Springs and streams rose everywhere in the fertile soil of Petra, and tall stone cisterns were built to collect the overflow against times of drought. Under the honesty and thrift of the Nabateans, Petra became the commercial meeting place of the ancient Orient and all of the Mediterranean world.

Up its narrow gorges and into its marketplace and cave-like warehouses, the laden camels brought their splendid merchandise: Tyrian purple, jewels, apes and peacocks, sweet cane from a far land, brocades, henna, frankincense, coral, orpiment, silk gauze, embroidery, carpets, slaves, perfumes, ginger, pepper and exotic little trees favored for their fruit or bloom. The Petreans themselves sold finely woven fabrics and unglazed pottery with painted designs of red and black. They supplied candles and lamps, bronze and copper utensils, molten mirrors, bread, meal, grain, cheese, curds, butter, oil and wine, large brawny cattle and black sheep.

As he entered the banquet room Aretas found his advisers, known as the "Brothers," already awaiting him. In spite of the rich hangings and carpets, low music and the fine foods set before them, their faces looked stern for they knew why they had been summoned here. According to the custom of Petra, the king moved about in his purple girdle and sandals, his Grecian ringlets flung back, serving his guests. Each man could drink only eleven cupfuls, and each drink must be taken from a separate golden cup. They were chatting among themselves about various aspects of the city's laws, and good laws they were, he thought. Women were respectfully treated and allowed to hold property. A man was fined for diminishing his substance and rewarded when he increased it. Householders did much of their own work, with the aid of a few slaves to take care of sanitation and the aqueducts. Even the king could be called to account for his private behavior, just the same as any common man.

When the food and drink were consumed and the musicians had stolen away, Aretas rose in the midst of them.

"Brothers," he said, "You know we are met here tonight to go to my rooftop altar and offer prayers to Dusares to protect us from the legions of Rome. Queen Shaquilath will repair to the High Place at sunrise and sacrifice a white lamb to our mother-goddess, Al Uzza, with a like request."

The Brothers bowed their heads and followed him up the stone stairway to the roof. Below them shone the lamps and hearth-fires of Petra. Perfumed smoke from other rooftop altars sweetened all the night, and the great bright stars burned overhead. Suddenly his son and heir, Obodat, spoke.

"Father," he said, "can we not take courage from what the soothsayers tell us? They have cast down the twigs and sheaves of arrows and noted the way they fell. They predict that this threat shall come to naught because of the death of a king."

Aretas smiled at his son as the group approached the golden altar with its squared black shaft of stone, the dwelling place of the god.

"Soothsayers are well enough," he answered, "but I had rather that Dusares told me so."

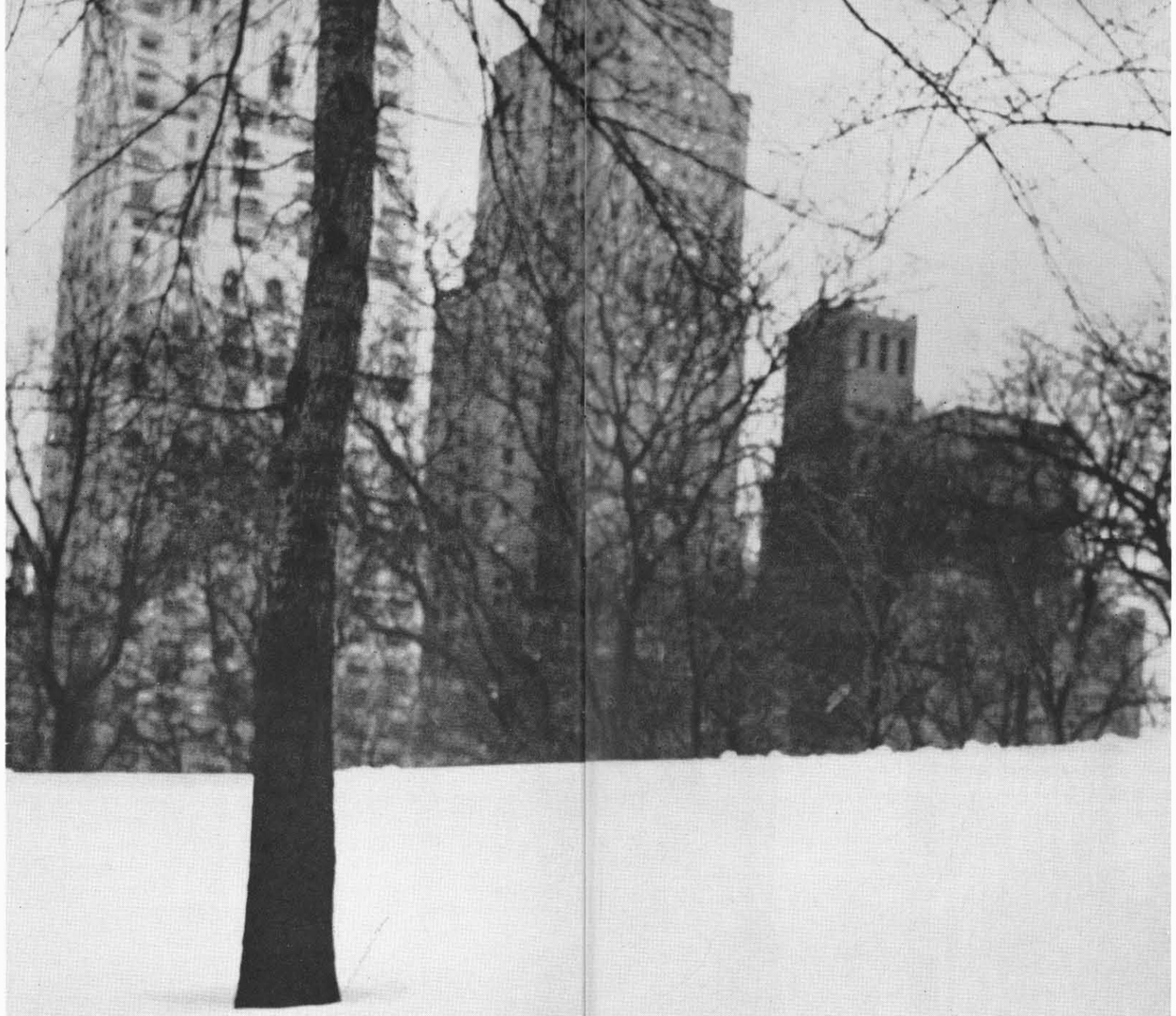
He raised his hand, and the Brothers knelt on the roof tiles while Aretas himself lifted a painted vessel from a silver tray. Solemnly he lighted the brazier of frankincense and began to sprinkle ram's blood over the tall stone, chanting the ancient ritual prescribed to save a city by prayer.

Apparently the ancient ritual was acceptable to Dusares, and in time the soothsayers' words were confirmed. Emperor Tiberius died in the year 37 A.D., and his threats against Petra came to naught. Rome made no move to subjugate Petra during King Aretas' reign. But in 106 A.D., several generations after Aretas' death, Roman emperor-soldier Trajan brought the rock city under the sweep of the *Pax Romana*. Petra's great days were over. Travel became safer and, with no need for a mountain refuge, caravans made their rendezvous at Palmyra as trade shifted to a more northerly route.

One of Petra's large tomb temples became a Christian church in 447 A.D. Later the Crusaders built their Frankish fortresses there. Then the Muslims held it for a time. But it is a deserted and empty ruin now, alone in the biting wind and burning sunshine, except when occasional desert shepherds come creeping back.

A tradition still persists that one day the ancient folk of Petra found a door in a rock leading to a rich and fertile subterranean land. The glimpse of it pleased them so much that, like the children who followed the Pied Piper, they entered and closed the door and made their dwelling there forever. But wherever they have gone, they have left the mark of their genius here, carved in the ruddy cliffs of eternal stone. ■

What keeps us warm?



When the wind howls and the thermometer plunges

the mind, as well as the body, bundles up for winter

How should a person dress when it's cold outside? For that matter, how cold is cold? At 10° *below* zero, a North Dakota farmer wears only a loose-fitting sheepskin jacket over his shirt to spend an hour in his fields. At 30° *above* zero, a New Yorker, walking the block from apartment to subway, puts a sweater over his shirt, a jacket over the sweater, a scarf over the jacket, and bundles a coat heavier than the farmer's sheepskin over everything! In both places, women wear only the thinnest nylon hose to cover their legs, while children, wearing about what their parents do, play outdoors for hours before they feel cold enough to come inside.

How can it be that the man in the more severe cold needs less clothing? How can his wife wear even less than he does? Why do children care less about the cold than their parents? The answer to all these questions is not so much a matter of climate as of the effects of climate on two distinctly human elements: mind and body. It may sound surprising but people wear clothes in winter not so much because their bodies need them but because their minds do!

As far as the body is concerned, the coldest it can ever get is minus 40° F. That's the point below which the cold receptors – nerves in the skin that tell a person he's cold – stop distinguishing differences in temperature. Though "40 below" sounds like terrible and unusual cold, recent findings by U.S. Army Quartermaster researchers indicate that nearly all the unclothed portions of the body feel nearly that cold during most of the winter.

Feeling cold is not a response to temperature alone, but to wind chill – a product of wind and temperature. And as far as the body is concerned, wind plays havoc with mercury readings. On a mild winter day in Chicago or Boston, for example, when the temperature is 38° and the wind force is ten miles an hour, a man feels just as he would at 27° below zero without a wind. With a slightly lower temperature or a slightly increased wind speed, he feels just as he would at 40 below!

Human bodies, however, seem to be in no great danger from such cold. Charles Darwin, who expounded the theory of evolution, reported that when he visited Tierra del Fuego at the southern tip of South America in the 1830s, the inhabitants wore no clothes and slept on the ground unsheltered. Clothing was unknown. When Darwin gave a Fuegian a shirt, it never occurred to the man to wear it. Instead he tore it into strips to use as ornaments. Yet the incident took place while it was snowing!

The Fuegian's protection – or any man's protection – against cold is internal. Polar bears, deer, horses, dogs, even tropical jaguars, are protected against cold by thick skins covered with hair or fur. Man has only a thin, practically hairless skin. He survives because when he feels cold, the flow of blood to arms and legs slows down, conserving body heat for the heart, lungs and other vital organs in the torso.

Barring exposure to extreme conditions for abnormal lengths of time, this internal mechanism keeps man safe from freezing. Women, with slightly more fat under their skin than men, are better insulated against cold. The wife, then, can be comfortable in thin nylons while her husband needs wool trousers. Children are more comfortable than adults because they seldom think of the cold and thus are less aware of it. In addition, running, jumping, throwing – the activities of, say, a snowball fight – all stimulate the circulation of the warming blood.

Some people think winter is fun, like this little girl romping in New York's Central Park.

Even the history of clothing shows that its value is more for the mind than for the body. So far as anyone knows, the first things man wore were not clothes but bits of stone, bone, feather and leaves. They were meant not to protect him from cold but to ward off evil spirits. Man invented the pocket before the pants by adding to these charms certain items of convenience – pouches, quivers, slings – that were useful for carrying weapons and food.

Only very late in his history did man wear anything recognizable as clothing – the skins of animals. These, too, were meant at first not to keep him warm but to endow him with the strength of the animals from which they had been taken. Only after wearing skins for thousands of years, and learning how to make cloth by weaving thread obtained by twisting plant fibers together, did it occur to man that robes could allow him to live in cold lands.

As recently as 2,000 years ago, man still used clothes more for ornament and to indicate his position in the world than for warmth. In ancient Egypt, where desert nights were cold, masters wore clothing, slaves wore nothing. In other societies, clothes showed whether their wearers were citizens or foreigners, nobles or commoners, shepherds or peasants. Today it is still possible to tell men from women by their dress and tell, further, which men are priests, soldiers, pilots, which women are maids, which are nurses.

As for the place of warmth in this scheme of things, it seems to have mattered little if at all. A Roman blue blood might in summer smother himself from neck to ankles in a toga to show the world he was a noble. A thousand miles north, in a far colder climate, a Norse chieftain would wear furs that left his shoulders and legs bare in winter!

Today, as always, custom determines what people wear to keep warm. The warmest natural fabrics known are those made from the hair of camels and two kinds of goats – the South American vicuna and the Indian cashmere. All three are technically wools – natural animal fibers that are thick and crinkly enough to trap pockets of air. These myriad tiny pockets of air absorb heat from the animal's – or wearer's – body more quickly than they radiate the heat to the outside air. Surrounded by a layer of warm air, the body itself is warm.

Camels and mountain goats are relatively rare, however, so most Americans and Europeans wear clothes made of wool taken from sheep. The sheep's natural protection is less warm for its weight than goat hair but is still more than adequate for man's purposes.

In recent years, more and more fabrics are being made from synthetic fibers – rayon, nylon and dacron, among dozens of others. These have the advantage, by and large, of being more durable than natural fabrics. Some, like nylon, are also virtually rainproof, since they shed water instead of absorbing it as natural fabrics do. No synthetic has yet proven as warm as wool, except in combinations with wool itself.

With these facts in mind, it is clear why clothing scientists answer the question, "What shall I wear to keep warm?" with questions of their own: "What are you used to wearing?" and "Are you a person who enjoys or dislikes cold weather?" ■

Containers of chilled laban get quick delivery to Riyadh merchants in scooter trucks. Sign reads "The National Dairy Plant."

The Riyadh Dairy

A young company in Saudi Arabia's capital city keeps an eye open for new products with public appeal

ABOUT TWO YEARS ago people in Riyadh, the capital of the Kingdom of Saudi Arabia, were puzzled by the appearance in food stores of a strange innovation: chocolate-flavored *laban*. They were probably unaware of the fact that they were participating in a simple, direct "market test." The chocolate *laban* was a new-product experiment of the National Dairy Plant of Riyadh, a market-conscious Saudi Arab enterprise.

Laban is the major product of the company. It has been described by Americans variously as "sort of like buttermilk," or "something like yogurt," or "a cross between sour milk and buttermilk." It is a favorite Saudi Arab dairy product and hardly a meal is served without *laban*. It is served chilled or is used in sauces and dips.

But, chocolate *laban?* The Saudi Arab palate said "No." Within a week the returns of unsold cartons from the food stores ended the market test. Pineapple, strawberry, honey, and chocolate yogurt may be popular in the United States, but the Saudi Arabs prefer their *laban* straight.

The modern-minded National Dairy Plant is owned by Fahad al-Gosaibi, a member of a well-known Saudi Arab merchant family, and 'Abd al-Fattah Mughatti. The spic-and-span plant went into operation about three years ago. In addition to *laban,* the company produces an excellent white Arab cheese and, in the summer months, vanilla and chocolate ice cream.

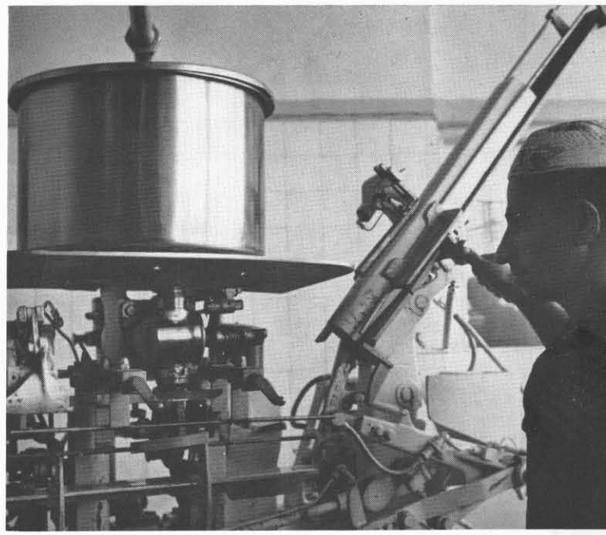
Always on the alert for new marketing possibilities, the National Dairy Plant also purchases and packages the surplus milk from the production of a herd of dairy cattle. Each day fresh milk is delivered by the company to the doorsteps of dozens of satisfied customers.

Like people the world over, the Saudi Arabs enjoy fresh milk – if it comes directly from a cow, camel or goat. In another product test the National Dairy Plant studied the possibility of marketing "fresh milk" from the stainless steel vats of their "mechanical cow." Again the customers turned thumbs down in favor of *laban*. Reconstituted sweet milk didn't make the grade.

But *laban* made from milk powder has been a success.

The processing of the company's *laban* is fairly simple. Milk powder comes from the United States in large drums. The butter comes from Holland. The individual waxed cardboard containers come from Canada.

The milk powder is combined with boiling water. The mixture passes through a high-speed blender where the butter is added. The *laban* is then chilled and pumped to the packaging machine. Three sizes of containers are marketed – half-pints, pints and quarts.



Blending apparatus, called "mechanical cow," mixes boiling water with milk powder from U. S. and butter from Holland.

Because production is fairly simple, the plant can quickly adapt itself to seasonal fluctuations in the market. The summer months are busy; the winters months fair and improving. During the blistering hot months – June, July and August – as many as 70 merchants purchase the *laban* for resale. The plant packages 800 half-pints, 480 pints, and 100 quarts of *laban* daily. The daily cheese production averages 30 kilograms. Volume customers include the hospital, the largest hotel, and (in summer) the Kingdom's military academy, which is in Riyadh.

The company's delivery fleet, small and economical, consists of two pick-up trucks and three Vespa scooter-trucks. Quality is maintained by the close control of every container of *laban* placed in the stores. Deliveries are made every other day, and unsold *laban* is picked up by the company, returned to the plant and destroyed.

Inside the plant strict, modern sanitary procedures are