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February 1961

FABULOUS FUNGUS

as Jack-O'-lantern, and *Panus stypticus* still send their glow through the local woods. But the phosphorescence is now attributed to *mycelium,* the threadlike part of the fungus.

Mushrooms come in many shapes. Some resemble bells. Others look like dainty parasols, Persian minarets, slender church steeples. Perhaps the most picturesque sight is the famed "fairy ring" — an enclosure of lush, dry grass around which mushrooms grow in a rough circle. Mythology explains that the Oreades, or wood nymphs, danced on this ground, but believers in the "little folk" claim that no grass will grow where a fairy or elf has set foot. Others believe that the rings were caused by the searing impact of a thunderbolt — that wherever the bolt strikes, the magic mushrooms will grow.

Science has explained, however, that the threads from a single mushroom spore spread radially at a more or less uniform rate as the soil becomes depleted of food the mushroom can live on. Thus, when mushrooms make their appearance above ground, they often form a circle. The yearly outward spread of these fairy rings is known, and from the size of the rings their ages can be reckoned. In England, there are some patches that have been estimated to be from 400 to 600 years old.

The early Chinese discovered a fungus with hallucinatory properties. They call it *ju-i* — or "as you wish" — and followers of the ancient philosopher Lao-tse, held that anyone fortunate enough to find a specimen in the deep forests would have a glimpse of paradise.

The *amanita muscaria* has long been a central prop in folklore, fairy tales and legends. Nearly 5,000 years ago, Tehuti, the Egyptian god of mathematics, described the red-crowned muscaria that inhabits the Middle East as the Plant of Life. Most of the ancient cultures held to this belief and were confident the plant bestowed the gift of immortality on those who partook of its fruits.

A prominent American business man recently wrote in a national magazine of an amazing mystical experience he attributed to the extra-sensory provoking powers of the strange *Psilocybe* mushroom. R. Gordon Wasson, a New York banker, traced the strange mushroom to a remote area of Mexico where the villagers used it in a potion to evoke oracular visions. Wasson persuaded them to let him take part in the rite and later told in detail of amazing sights he beheld before him in the darkness of the Indian hut — shining palaces encrusted with jewels, exotic gardens, mythological beasts . . . .

"The visions came whether our eyes were open or closed," he said. "They emerged from the center of the field of vision, opening up as they came, now rushing, now slowly, at the pace that our will chose. They were vivid in color, always harmonious."

Fact or fancy, mushrooms have intrigued man's imagination, as well as his appetite. ■

Aramco World

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Mushrooms garnish some of the world's fanciest foods, but there are 37,000 varieties of the fungus that have no business on the dinner table.

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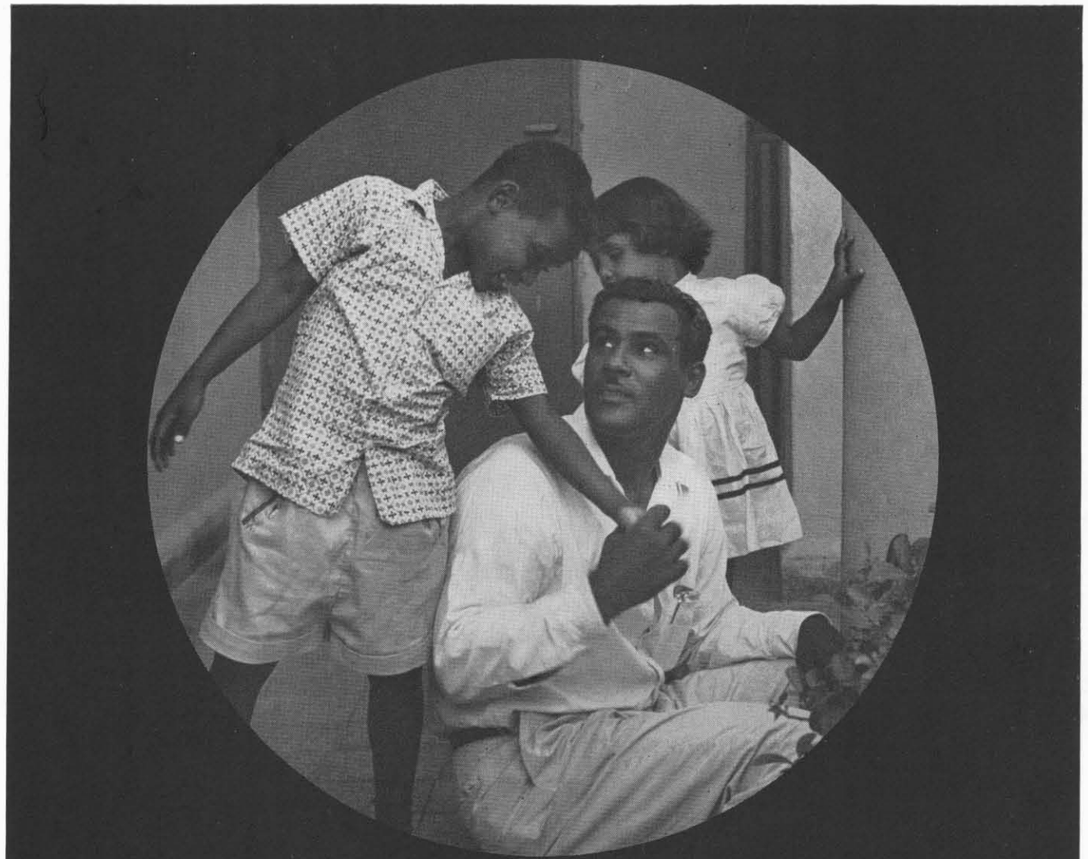


"Togetherness" is an old, old idea among the closely-knit families of Saudi Arabia

A VISIT WITH SAAD MUHAMMAD

IN Saudi Arabia, most people never heard of family *togetherness*. But no other pattern would ever occur to them. None ever has.

Sit around and visit with any Saudi Arab friend or acquaintance, and you'll understand this very quickly. Take Saad Muhammad, for example. Saad is the *muraqib*, or foreman, in Aramco's welding shop in Dhahran. One of the best. For several years he was an instructor.

After working hours, he's a husband and father — a family man.

The scene in his home in Dammam has things about it that are just like life in your own home — and things that are different.

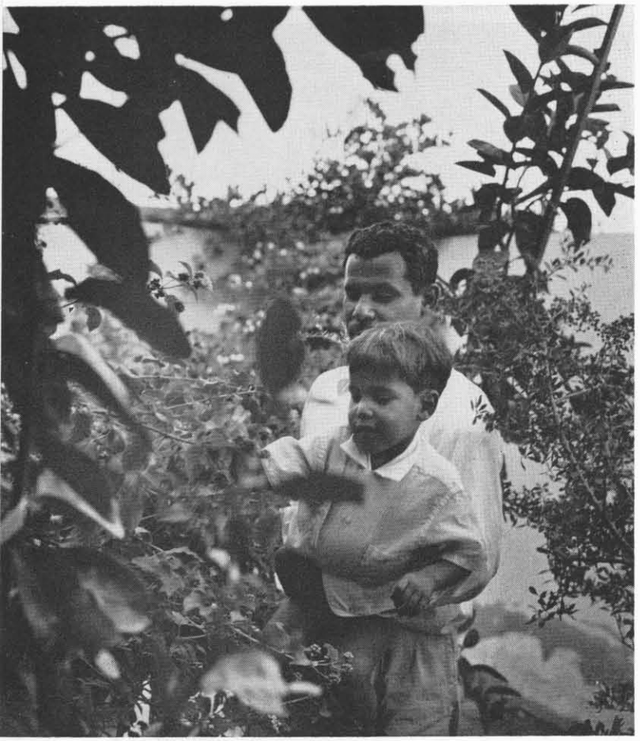
During early evening when the day's work is over and dinner has been enjoyed, it is family time.

"I like to play with the children," Saad explains, leaving no doubt. He has seven: two boys, five girls.

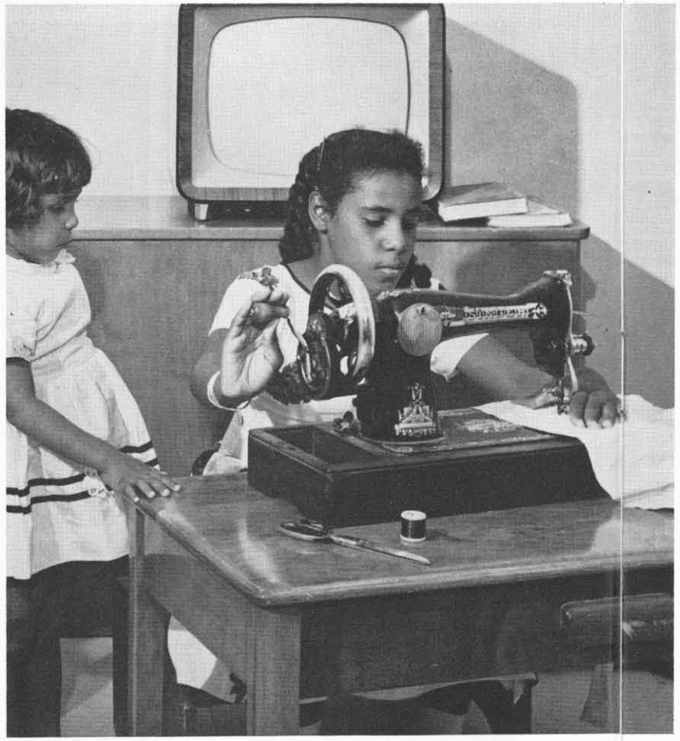
The oldest is Latifa. The other girls are Miriam, Manra, Haie and Farida. The boys are Omar and Jamal.

The children love to play with their dad, too. There's a nice, warm feeling during family time. Probably it's due to the mutual appreciation and satisfaction of the group performing as a family unit. Saad and a couple of the boys might play a game quite like "horseshoes." A couple of others sit with their mother, watching "Storytime" on television. The youngest are in bed, but the sounds give them a good feeling of security and belonging. Latifa sketches very well and Saad is proud of her talent. "Sometimes she paints; sometimes she sketches," he modestly explains.

A favorite game in which almost everyone can partici-



Saad Muhammad instills in his family love of outdoors and things that grow. He gives Jamal a botany lesson in garden.



Latifa, as the eldest child, takes her seniority seriously, and tiny Farida waits for the day when she too can help mother.

A VISIT WITH SAAD MUHAMMAD

pate, is played out in the yard. Saad makes a small, shallow hole. Then he puts down a dried lime or some other dried-out fruit maybe 6 inches from the hole for a beginning tot, 12 to 14 inches for an older player. The trick is to stand from 8 to 18 feet away from the line – depending on how adept you are – and toss a 4-inch ring so it will hit the lime and push it into the hole.

"Sometimes," Saad mentions, "a toy or some other prize will have amazing effect on everyone's aim. When you have seven children, you can't always buy something for all of them, you know."

But, family time is not all play. Latifa attends a private school, and Omar, 7, goes to one of the Government schools. So, there's home work. And, like children everywhere, these youngsters appreciate a helping hand from their dad. To help Latifa with her mathematics, Saad even brought home a blackboard.

Sounds pretty much like an average American home, doesn't it? But, it's not all the same. Take the matter of shopping: generally, the husband does the shopping.

The reason is that woman's position in Arabia is much different from what it is in the Western countries. She lives in full privacy and is not seen by men other than her husband and close male relatives, or, in appropriate circumstances, long-time family friends. In the homes of rich and poor and in the tents of the wandering Bedouins, the women have separate quarters. Only men who are intimate members of the family may enter there. When women go outside their homes, they are heavily veiled.

But, does the husband do *all* of the shopping – food, furniture, house furnishing, dishes – all these things?

"That's right," Saad assures. "Oh, sometimes women go to the store for a few groceries, and we go together to buy the children's clothes, but usually the husband does it."

While he's gone at work all day, Saad's wife and the children will attend to chores around the house: the cleaning, washing, ironing, sewing, gardening and so forth. Instructing the children in all these household duties is one of Saad's wife's responsibilities.

"When she's not in school," you learn from Saad, "the oldest girl does all the cooking. She and the other girls can use the sewing machine, too."

Indeed, helping with the household chores is part of growing up for every Arab child, especially the girls, just as it is in Vermont or Kansas. And, just as in Vermont and Kansas, this gives the wives their chance to get together and chat.

One difference, though: there's no talking "over the back fence," because there's no fence. *Every* home is surrounded by a wall which forms a secure little compound. The chat sessions are indoors.

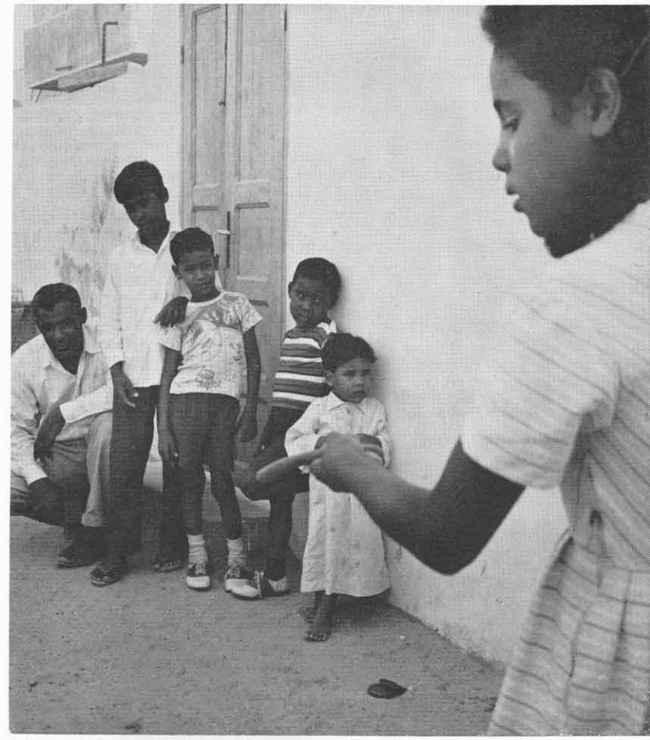
In Saudi Arabia, Saad claims the *husband is the boss.* No doing dishes. No cooking. Fixing things around the house, yes: a faucet out of order, an electric outlet not working – things like that. And helping discipline the children. Otherwise, no.

"Before I leave in the morning," Saad says, "I say what I want for dinner. Maybe it's meat, or fish, or chicken, or whatever. I say what I want, and that's what we will have."

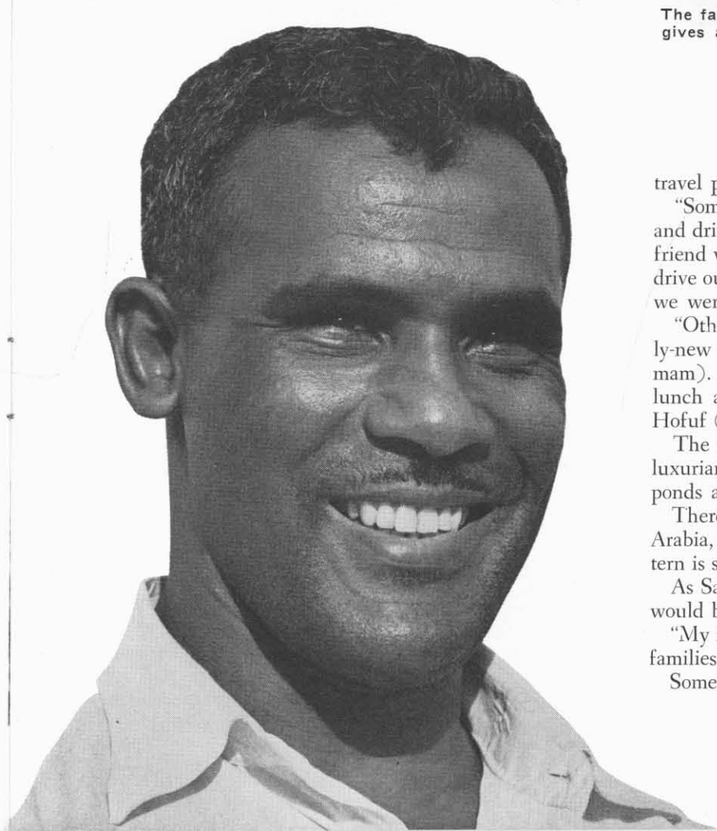
"There are no arguments. Oh, maybe my wife will say, 'Why do you do this?' or 'Why don't you do that?' And I'll think it over, and if she's right, I'll do what she wants. But the husband is boss.

"On my days off, we do different things," Saad recalls. (Aramco employees are off on Fridays – the equivalent of our Sunday. Thursdays are alternately off-days or half-days.)

Sometimes, just sleeping late and taking things easy is what they feel like. Maybe Saad will do some reading. Later in the day, some men friends may drop by and pass the time in his *majlis* (living room). His wife may have some women visitors in her own rooms where they can exchange stories about their children or perhaps watch television. Like housewives anywhere, they enjoy programs that feature tips on home-making, as well as ever-popular travel programs that everyone seems to appreciate.



The favorite game in the yard is similar to horseshoes and gives an opportunity for some spirited family competition.



"Sometimes, we'll get in my car – the whole family – and drive to the beach," Saad explains. "I have a very good friend who lives near me, and often he and his family will drive out with us. We have all known each other ever since we were small children.

"Other times, we will go to al-Khobar (a thriving, mostly-new shopping center of about 25,000, south of Dammam). In the winter when it's cool, we like to take our lunch and go to the gardens in Qatif or even down to Hofuf (about 90 miles away)."

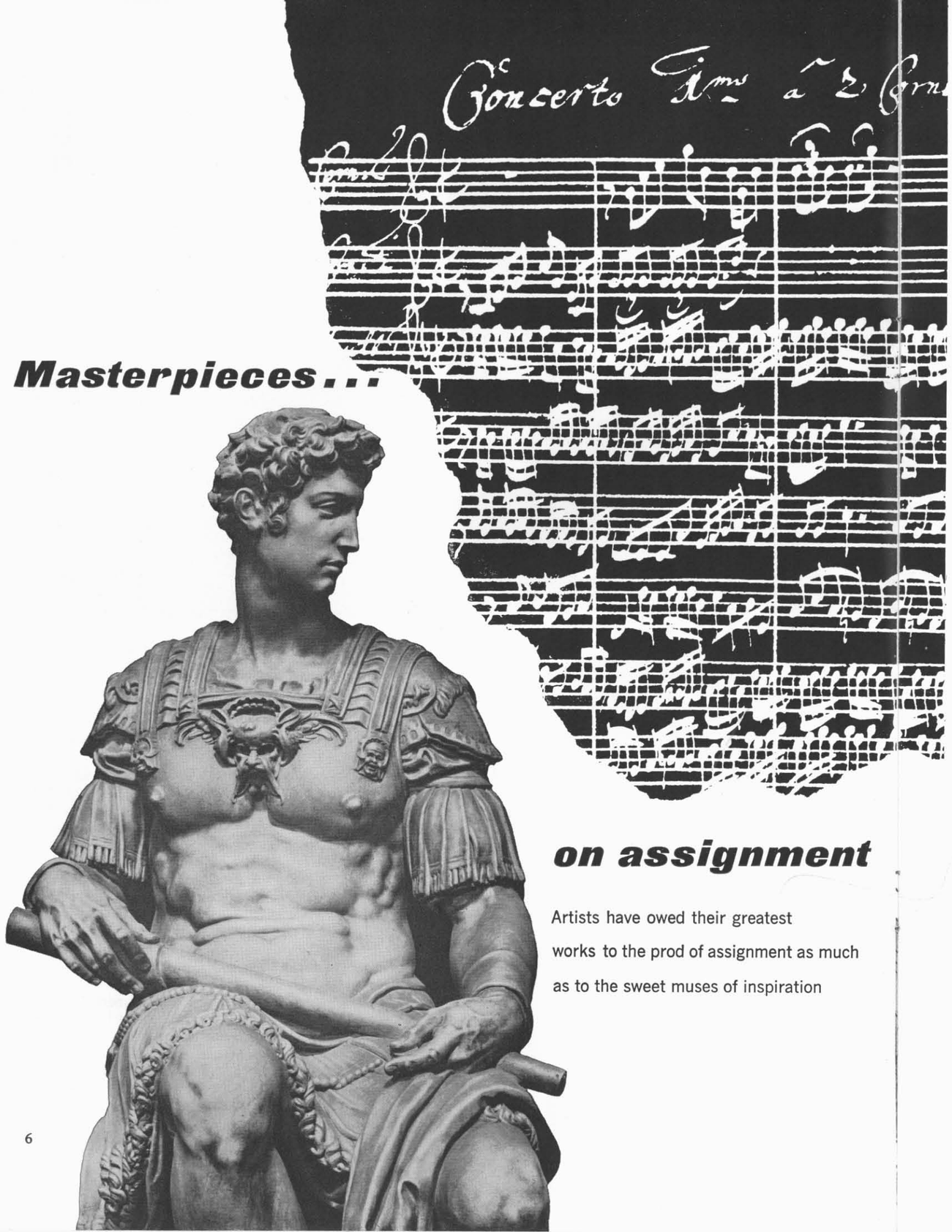
The term "gardens" is used in Arabia to designate the luxuriant oasis areas, with their thousands of trees, flowers, ponds and streams.

There are variations, of course, in family relationships in Arabia, as everywhere, but one element of the basic pattern is strong and enduring: *family unity.*

As Saad was saying when you mentioned that tomorrow would be Friday and asked him what was he going to do:

"My friend and I are going to get into our cars with our families and go fishing."

Somebody should tell him about *togetherness?* ■



on assignment

Artists have owed their greatest works to the prod of assignment as much as to the sweet muses of inspiration

Good examples of great music and art done to order are Bach's historic "Brandenburg Concertos" and Michelangelo's magnificent statue of his patron, Guiliano de Medici.

COUNT KAISERLING, an eighteenth-century Russian ambassador to the Court of Saxony, was a chronic insomniac. Friends and relatives provided the Count with their favorite remedies, but all to no avail. Having exhausted the common remedies, the Count continued to toss and turn in his silken sheets. Then, out of sheer desperation, he looked over his retinue and summoned a harpsichordist named Goldberg, a pupil of Johann Sebastian Bach. Knowing Bach's great reputation as a composer, Kaiserling and Goldberg asked him to write some charming music designed to assuage wakefulness. Not too much later, the Count received a theme with 30 variations, and Bach, in turn, received a goblet filled with 100 *louis d'or* coins. Apparently when Goldberg played Bach's theme and variations, the Count henceforth slept soundly.

Few music critics would deny that Bach's masterpiece for the harpsichord, grandfather of the piano, is *The Goldberg Variations,* and most feel that it is a work unmatched in its century for brilliance, poetry and warmth of imagination. "The modern pianoforte has little to show in advance of *The Goldberg Variations,*" according to one noted musicologist. Yet the origin of this masterwork may strike music lovers as curious, even disenchanting.

The Count, as a music lover, is certainly placed in a dubious light. But more disturbing, perhaps, is the idea that Bach could have been unromantic enough to compose his masterpiece *to order,* an idea that runs contrary to the nineteenth-century conviction that great works of art are the products of sudden and overwhelming inspiration. Maybe the story would be more satisfactory if the Count were erased altogether: it would then be possible to visualize Bach awaking one night from an inspired dream, staggering to his desk half asleep, and feverishly jotting down the music that raced through his head — and by dawn there lay the theme and 30 variations, a finished masterpiece! But the ineradicable fact is that the Count, not inspiration, ordered it.

Paintings, likewise, ought to be created by acts of pure inspiration, according to romantic notions. It is pleasant to imagine the artist idling along a street and seeing a beautiful face. He is inspired and murmurs, "By heaven, I must paint that face!" He follows the owner of the face until he dares to speak to her; he persuades her to sit for him. Result: a *Mona Lisa.* But the unromantic fact is that the distinguished Francesco del Giocondo wished a portrait made of his third wife, Lisa di Noldo Gherardini, and commissioned Leonardo da Vinci to paint it. Most portraits have originated in this same way. The fact is that there is no art that has to be created solely by inspiration.

Bach's experience with Count Kaiserling was typical rather than unique. His six *Brandenburg Concertos* have been the admiration of the world not only for their beauty, but for their historical importance in enlarging the scope of the concerto by using all kinds of instruments for solo parts. He wrote them because he was asked to write them—by the Margrave of Brandenburg, a gifted amateur, who was making a collection of modern concertos and did not overlook the greatest genius of his time. Bach never had the pleasure himself of hearing them performed. But he probably didn't mind: he was too busy composing other works which had been ordered.

Bach's greatest contemporary, Handel, turned out an enormous volume of operas — one every few weeks! — at the command of his royal patron, George II of England, and instrumental pieces galore for his young pupils, the King's children. One of his most remarkable compositions, the orchestral suite known as *The Fireworks Music,* was ordered for the commemoration of the Peace of Aix-la-Chapelle in 1749.

Before Bach, one of the most gifted of composers was François Couperin. His steady stream of flawless music was written to supply, as he was commissioned to do works for the Sunday afternoon musicals which Louis XIV held at Versailles.

During the eighteenth century not only kings but every sort of prince — important or petty — gathered creative artists about him. In Central Europe almost every count or bishop had his court musician, organist, composer, orchestra and choir. None of these patrons expected to wait until inspiration came to their composers. If they were composers they were expected to compose, to supply the musicians, orchestras and choirs with a steady output of new music.

For thirty years Joseph Haydn, son of a wagoner, lived as court musician to Prince Nicholas Esterhazy, a Hungarian nobleman, at Eisenstadt. He was called upon for daily concerts and numbers of operas, and was exceedingly happy to turn out for three decades an almost endless succession of compositions to fill the demand. Far from feeling enslaved, he looked upon himself as a child of fortune, until the Prince's death in 1790. It was after that event that he signed a contract with the manager, Johann Peter Salomon, to come to London and write six new symphonies. At the age of 60 he thus undertook the first extensive voyage of his life. Haydn was a great success in London, and there, between March and May of 1791, he wrote not only the six new symphonies (among his greatest), but also string quartets, orchestral suites, a trio, a cantata and many songs! Three years later, Salomon induced him to come to London again and contracted for six more symphonies. Like many of the world's greatest creators, Haydn was a simple, gentle, methodical and industrious man, very much loved by those who knew him, and rejoicing in his steady employment.

Mozart, whose career was more subject to the whims of fate, was happy when he could create under similar conditions. The Emperor Joseph II commissioned one of Mozart's first important operas, *The Abduction from the*

MASTERPIECES ON ASSIGNMENT

Seraglio, in 1781, and subsequently commissioned one of his latest works, and one of his most glorious, *Cosi Fan Tutti,* in 1790.

If great composers were expected to deliver great music, many noblemen took equally gravely their responsibility to see that music flourished. Even the revolutionary-minded and uncompromising Beethoven was glad to have their support. The three celebrated string quartets which form his *Opus* 59, for example, were commissioned by Count Rasoumovsky, himself a fine musician. And in 1809 a striking incident occurred in Beethoven's career. Jerome Bonaparte, King of Westphalia, offered him the post of Master of the Chapel at Cassel at a good annual stipend. But three men of rank, the Archduke Rudolph (the Emperor's brother), Prince Lobkowitz and Prince Kinsky, were so alarmed at the prospect that Vienna would lose Beethoven that they agreed to bestow a regular income upon him if he would stay.

Composer Handel turned out a huge volume of opera for royal patron King George II (left).

Nor did such conditions diminish the dignity of the creator. The London Philharmonic Society in 1818 sent Beethoven a commission to write a new symphony for them. This would have been the Ninth Symphony, and he was delighted at the opportunity to compose it. But when it was made clear to him that the London Philharmonic wished a work in his earlier, less iconoclastic style, he turned down the offer altogether, refusing to compromise his principles.

Writing upon commission continued through the nineteenth century. King Charles X of France appointed Gioacchino Rossini "First Composer to the King," and commissioned him to write five operas. The first was *William Tell* (1829), a work of epochal importance to opera. Unhappily, the overthrow of Charles voided the contract for the other four operas.

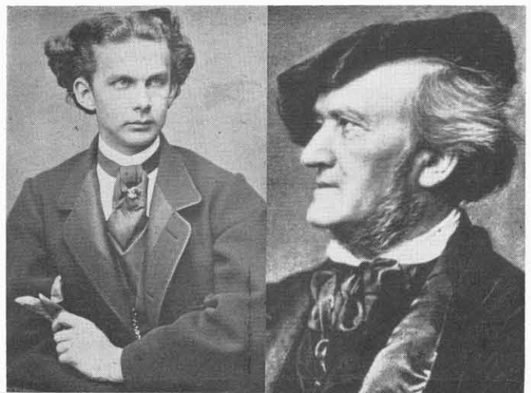
Richard Wagner was already 54 and desperate over his debts when Ludwig II, King of Bavaria, summoned him to Munich to work under the royal protection.

But this delivery of masterpieces upon demand was by no means limited to music. In painting it was not only the formal portraits which were commissioned. Painters during the hey-day of the Renaissance did not accumulate a series of paintings and then wait for someone to buy them one at a time. They worked usually when and because they were commissioned to work.

It has sometimes been a subject for wonder that so many of the world's greatest paintings have so many unappealing faces in them. When they do, it's a safe bet that the face belongs to the patron or one of his close relatives, whose presence in the work he stipulated. And, even that stipulation was no impediment to the beauty-loving artist. The commission, not the faces, was the incentive to the creation of beauty.

When the faces have been beautiful, that too has been, more often than not, part of an order to paint, as the two masterpieces of the exquisite Botticelli prove. That deathless Venus rising from the sea is a portrait of Simonetta Vespucci, the mistress of Giuliano de Medici, and it was he who commissioned the work. Botticelli's other most celebrated work, the *Primavera* was commissioned by Lorenzo the Magnificent to commemorate the tournament of Giu-

When King of Bavaria, Ludwig II (left), became patron of Richard Wagner (right) in 1867, Wagner, then in his 54th year, began writing such great music as "Die Meistersinger."



Romantic tales stress Leonardo da Vinci's inspiration in painting 30¼" by 20⅞" tempera panel "Mona Lisa" in 1503, but actually the artist was commissioned to do the job.

liano in 1475 in honor of the beautiful Simonetta, and she again appears as the central figure.

One of the most dramatic stories of the Renaissance is of the painter known as Fra Bartolommeo. After the burning of Savonarola, whose disciple he had been, he became a monk and vowed to paint no more. For six years his superiors in the Dominican Abbey entreated him to go back to his great gift, but he refused. At length, pressed by Bernardo del Bianco's constant pleas to paint a Vision of St. Bernard and urged to comply by the wise Prior of San Marco's, he took up painting again – to begin the period of his greatest creations. Had the commission not offered the incentive, the world would have been the poorer for loss of his best paintings.

Some of the greatest achievements of Raphael and Michelangelo resulted from orders from their papal patrons –the Sistine Chapel is ready proof.

The case has not always been different in literature. Shakespeare himself probably began his career by being commissioned by his company manager to rework some old plays on the War of the Roses, with the resultant *Henry VI* plays and *Richard III.*

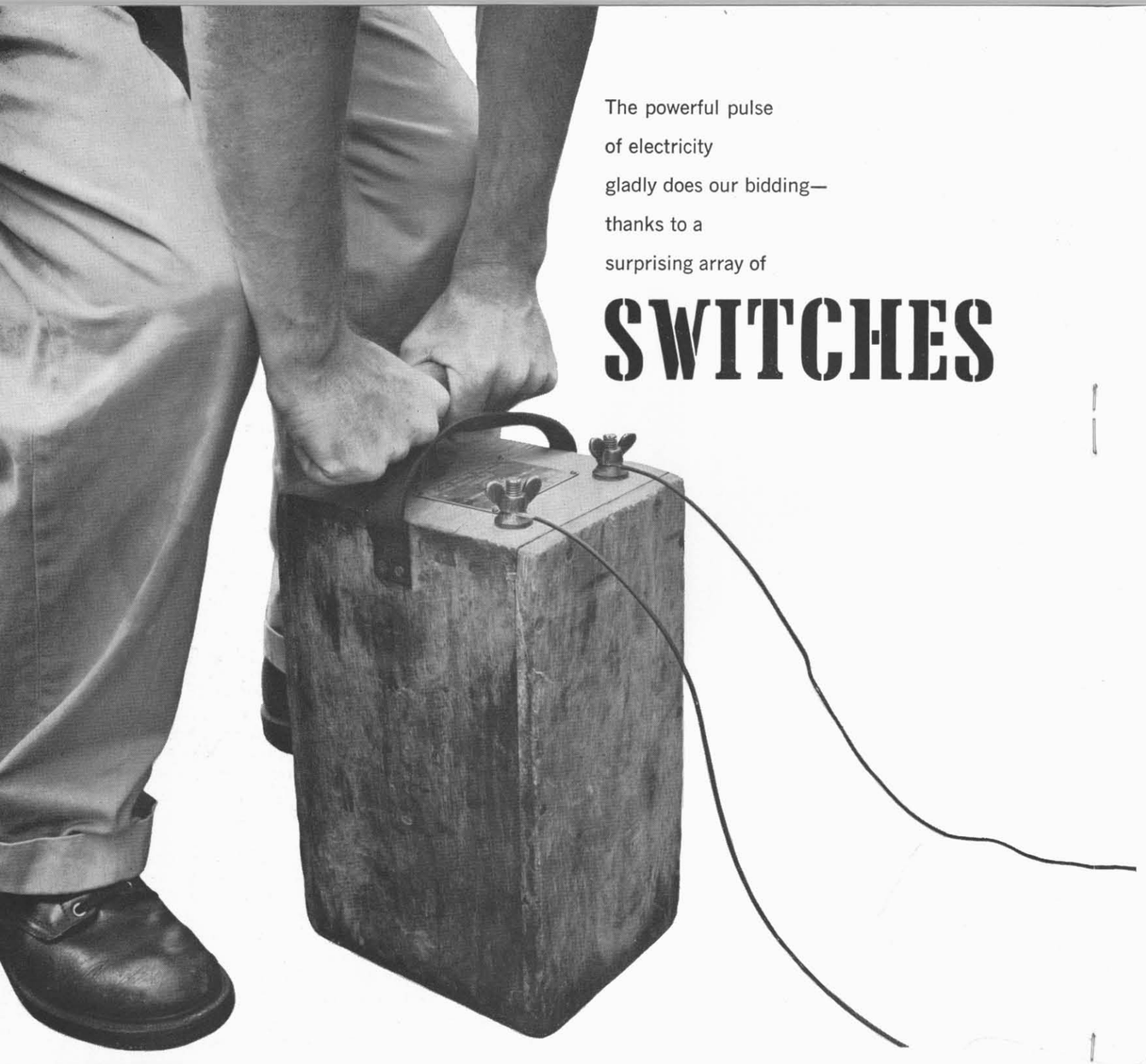
One of the most lucky of literary commissions was that which gave the world the delightful *The Rape of the Lock,* from the pen of Alexander Pope. In real life, a certain Lord Petre had cut off a lock from the beauteous head of Mrs. Arabella Fermor. As Dr. Johnson later describes the results of that act: "This whether stealth or violence, was so much resented, that the commerce of the two families, before very friendly, was interrupted." It happened that both families enjoyed the friendship of a Mr. Caryl. He "solicited Pope to endeavor a reconciliation by a ludicrous poem which might bring both parties to a better temper." Pope wrote the mock-heroic lines and sent them to the offended lady, who liked them very much. Why she did, no one knows, for their devastating satire was at the expense of everyone concerned. But nowhere in the whole range of English literature will there be found a more delightful play of pointed wit than in this commissioned work. No Mr. Caryl, no *The Rape of the Lock.*

Literature is full of examples of commissioned art, as far back as Anglo-Saxon times in England, where each tribe had its own king. No man was dearer to the king than his *scop,* who was employed just to compose poems that celebrated the glorious deeds of the king. Scholars have also suggested that Chaucer wrote his charming *The Book of the Duchess* at the specific request of the Duke of Lancaster, Chaucer's patron, in commemoration of the death of the Duchess of Lancaster. Ben Jonson, Shakespeare's friend and rival, began a new career in 1605 as the result of an appointment to the court of James I. Jonson was commissioned to keep the court entertained with a series of masques – playlets built around mythological tales – and the security the court commission provided gave Jonson the chance to discover a true genius for delightful fancy.

One of the best examples of literature written to order is John Milton's poem *Lycidas,* often called the best lyrical poem in English. When Edward King, a schoolmate of Milton at Cambridge, was drowned, a group of friends decided to publish a book of verse in his memory. Milton, an acquaintance rather than a friend, was solicited for a poem. *Lycidas,* which he humbly signed "J.M.," became one of the chief glories of the English language – yet it was done on assignment.

In short, the history of the arts indicates that the creator is one who creates without waiting for inspiration; he would seem to be inspired all the time and the fact that he has contracted to produce art apparently has only beneficial results. The world would be much poorer, indeed, were it not for artists of the past who kept an eye on their pocketbooks, as well as an ear to the voices of inspiration. ■

Composed by Igor Stravinsky in 1913, "Petrouchka" is an excellent example of a masterpiece in ballet done to order.



The powerful pulse
of electricity
gladly does our bidding—
thanks to a
surprising array of

SWITCHES

THE burglar could hardly be blamed for his failure. He made a bold, daylight attempt at a holdup, and he frightened the bank employees so much that they were willing to open the vault — if only they could have. No one, not even the bank president, could open the vault, not until 9:00, the hour when a time switch would relinquish its absolute control over the heavy steel door.

The ingenious device that protects bank vaults is but one of a group of contrivances that constitute one of modern man's most useful yet most common mechanisms. A switch may be described as a device for regulating the flow of something. If we disregard the railroad switch and the valves and sluice gates that control systems of liquids and gases, we are left with those devices that regulate the flow of electrical energy. Of these there are probably at least a few million varieties.

One company that manufactures switches for industry and for aviation offers 6,000 different models. Another firm produces a push-button switch assembly that contains thirty-eight components. Simple? Perhaps, but there are an estimated million and a half ways to assemble those parts. No one has counted the maze of switches in a Univac electronic "brain," but an engineer who knows his way around the parts catalogs considers his estimate of "at least 100,000" to be conservative.

The common wall switch that bathes a room in light with the flick of a finger is a good one to use in examining the basic function of all switches. Despite its simplicity, it is a device that in effect puts the local power company at our command, for the electricity that surges from the power plant's generators is never "off." Behind the wall switch's brass or plastic covering plate, a pair of wires (the "circuit") are connected to two terminals. The actuating lever, or toggle, connects the terminals when in one position and doesn't in the other. In short, then, a switch simply makes or breaks a connection. It is a drawbridge that permits or prohibits the passage of electrical energy.

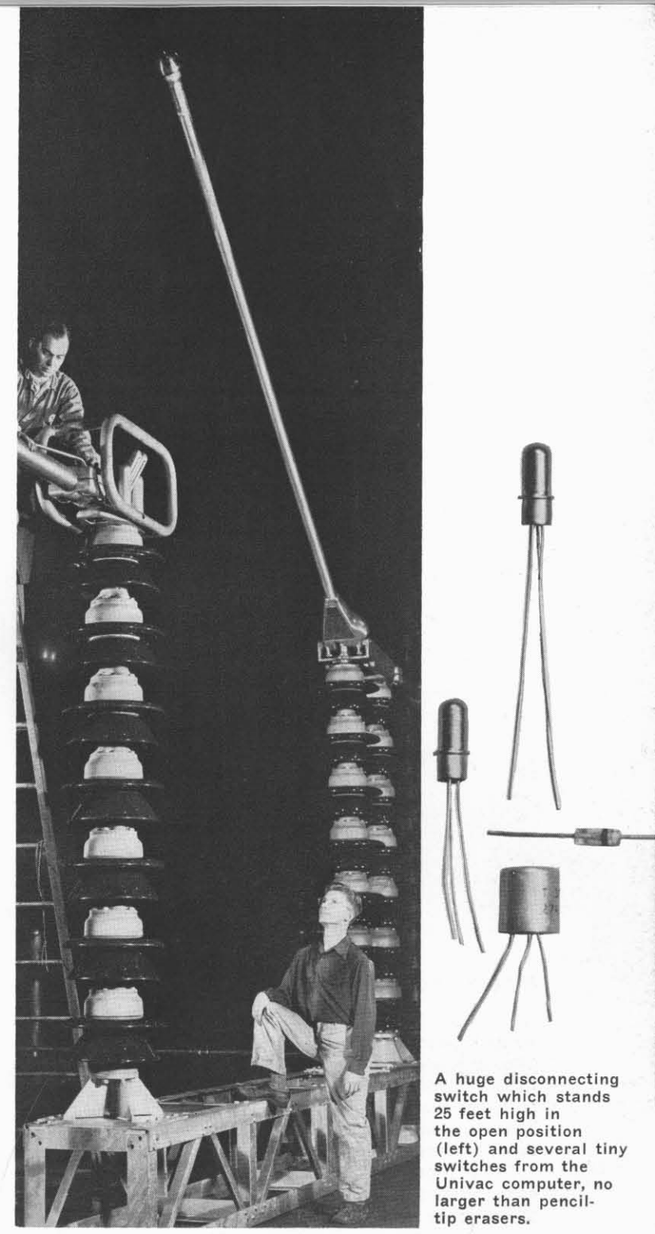
Among the common types of switches, besides the familiar wall switch and the pull-chain or knob on a lamp, are a few stereotypes that figured prominently in old-time melodrama. The one clutched by a "mad scientist" who is about to blow up the world, or a villain, crouching in the basement, who is about to cast a building into darkness, is called a knife-blade switch. Another favorite among villains is the box and plunger that will touch off a charge of dynamite planted under the heroine, unless, of course, help comes in time.

Other switches are less familiar but more useful. Among them are the working parts of the telephone. The instrument itself is little more than an on-off switch (the cradle), a multiple switch (the dial), and a combination microphone and miniature loudspeaker. Between telephones, however, is a fantastic array of switches that fill huge rooms at the telephone company building. Called relays, these switches serve as did the old-fashioned switchboard (which was fairly complicated itself) and as the operator's hands as well. As you dial a number, relays close in the proper sequence until you are directly connected with the telephone being called. Another switch rings the bell intermittently, or else still another switch actuates the busy signal.

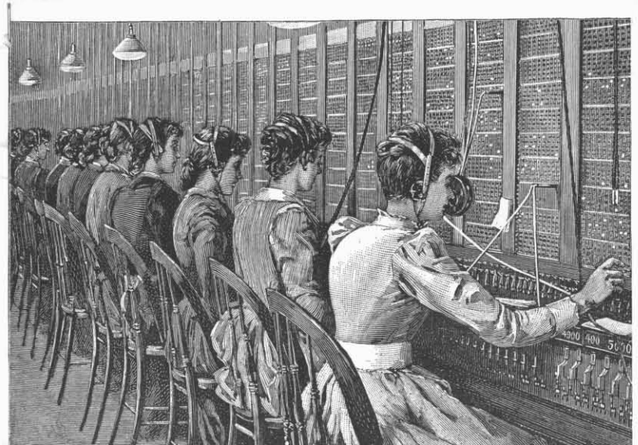
Switches not only heed instructions that would otherwise have to be verbal, but they can actually substitute for all the senses except smell, providing they are outfitted with appropriate sensing devices. They can be actuated by light, heat, weight or pressure, magnetism, vibration, humidity and even color. They can be constructed with a built-in memory. These obliging gadgets, called time switches, change traffic signals, snap on street lights or store window lights at dusk and off again at dawn, control chemical processes, guard bank vaults and perform hundreds of other useful tasks. The heart of this sentinel is a motor-driven dial that rotates at a predetermined rate, ranging from every second (or even less) to once every day or week. They can even be set to skip weekends and holidays.

A clever engineer in Cleveland, who always played with his dog when he got home from work, rigged his tape recorder with a time switch when he went away overnight. At 5:20 P.M. a recording of the master's voice put the canine through his tricks and presumably kept him from becoming too lonely. At 5:30 the machine was shut off and a buzzer sounded in the neighboring apartment to announce that it was time to serve Fido the horsemeat.

Switches are in the safety business, and they undoubtedly save scores of lives every day. Machines are said to "shut



A huge disconnecting switch which stands 25 feet high in the open position (left) and several tiny switches from the Univac computer, no larger than pencil-tip erasers.



Automatic relay switches now do the work of old-fashioned telephone company switchboards.

themselves off" when a dangerous situation arises; actually it is a safety switch at work. Excessive steam pressure or mechanical force, leaking poisonous gas, or vibration created by loose components may shut down an operation until the fault is corrected. Many machines are routinely turned off when an access door is opened, much the same as the light in a refrigerator is switched on.

Many of the safety devices are called "limit switches" – that is, they are actuated when a predetermined limit is exceeded. The most common of these, and one that maddeningly destroys itself when it operates, is the ordinary household fuse. An overload of current, caused usually by plugging too many appliances into the same circuit at once, burns a strip of metal in the fuse that is rated to carry no more than a specified amperage. Even as it earmarks itself for the junk heap, the humble fuse saves the home from possible fire and perhaps saves some of the precious appliances from damage as well.

In industry, and more and more in the home, the one-shot fuse is replaced by the circuit breaker, which performs the same function of severing an overloaded circuit but does not destroy itself. The box with a button marked "push to reset" that is found on many household furnaces is a circuit breaker.

A type of circuit breaker is the world's largest electrical switch, and it is one familiar to most motorists. Spotted at regular intervals along high-voltage, long-distance power transmission lines, which often follow highways, are complicated-looking structures of narrow girders, giant insulators, and huge metal tanks. The tanks contain over-sized circuit breakers that regulate the voltage carried by the line. Should there be a sudden surge of power, as when lightning strikes the line, the circuit breakers open and close quickly until lightning arresters have drained off the excess charge. The structures may be as much as four stories high, and the energy coursing through the line may be as high as 230,000 volts. A charge of that magnitude can jump, or arc, across a considerable gap, so to prevent arcing when a circuit breaker opens, the tanks are filled with oil or compressed air.

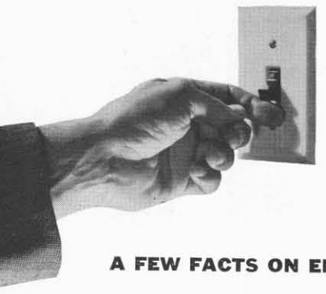
The smallest switches made today are literally out of this world. Designed by space scientists, they are tiny transistors that operate recorders, transmitters, and other devices that must be packed into the limited confines of a small satellite. Each is no larger than a kernel of corn and weighs no more than an ordinary paper clip.

The marvelous doings of satellites and such fantastic realities as the fully-automated factory, where switches replace people for nearly all operations except sweeping up, are scarcely more remarkable than many accouterments of everyday modern life. When, for example, the supermarket door courteously opens itself for us, we are indebted to a switch employing a photo-electric cell. Mounted opposite a light source in front of the door, the cell generates a weak current that keeps the switch in the open position. When the beam of light is interrupted, the current is shut off, the switch snaps shut, and the door-opening mechanism is activated.

Dozens of educated switches help govern life in the kitchen and the utility room, but the most-used switch in the home, at least during prime viewing hours, is the back end of the television tube. It regulates a beam of electrons that scan the screen and thereby "paint" a picture. A single line is scanned at a time, and there are 525 lines on the American screen. Thus, with a complete picture presented thirty times a second, a total of 15,750 lines are scanned each second. What's more, the brightness of the dot of light produced is almost continually changing – as often as six million times a second.

The earliest type of switch is seldom used these days, but once it was found in nearly every one-room school. Although it's not electrical, its purpose is regulative and the results of its use might be called electrifying. It is often made of hickory and is the only type of switch that fits the meaning of the word in its original form: *swutsche* (German), a long tapering stick or diversion from the main trunk of a tree.

Quite possibly the original meaning of the word will die out altogether before too long. More uses for electricity are steadily being discovered, and wherever a current flows, no matter how weak or how strong, it is certain that there are switches to control it. ■

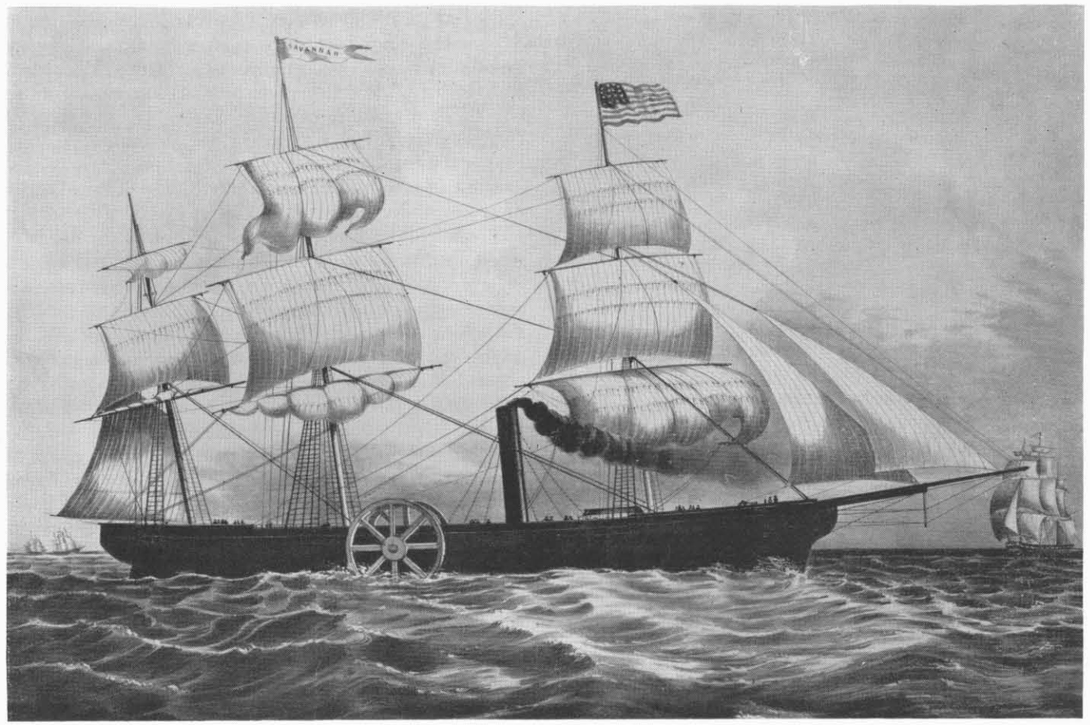


A FEW FACTS ON ELECTRICITY AND SWITCHES

By its inherent nature as a continuous stream of billions and billions of electrons (invisible, sub-atomic particles of electricity), moving under a pressure called **voltage,** electricity always generates heat in its path and seeks the shortest route. The rate, or intensity, of flow is measured in **amperes;** the work done, in **watts.**

Before it can perform work electricity must be assured of a complete circuit—an unbroken pathway from the source of power, to the point of use, and back to the source again (or to the ground in the case of a "grounded" circuit). If the pathway is intersected by a switch—the connecting link between the two distinct halves of the circuit—electricity flowing along the circuit performs work when the switch connects the two halves, no work when the switch disconnects them.

The switch, then, is a very important middleman; in effect, it decides whether the flow of electricity is to be used or unused. In its simpler forms, it puts the local power plant on call at all times, as, for example, when a person flicks a wall switch and thereby cuts a light bulb into the onrushing stream of electrons. The wall switch, like the knife and plunger switches and all the rest of the "Off/On" group, exists solely to control the flow of current and is one of two basic types. The other is the less obvious, usually hidden, type that is triggered by the current itself—the time switch, for example, that changes an automatic washer's cycle from "wash" to "rinse."



STEAM GOES TO SEA

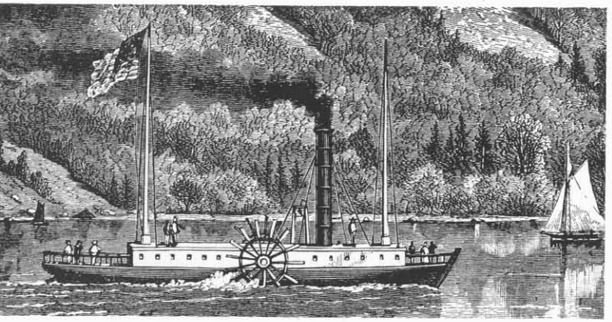
In 1819 no one except Moses Rogers dared the sea in a novelty like a steamship

ON a sparkling June 17th, 1819, the attendant at the Cape Clear telegraph station, southernmost tip of Ireland, glanced out the window at the familiar expanse of water, blinked, stared intently again and then raced for the flag-locker. Quickly the alarm was relayed up the coast. "SHIP ON FIRE!"

HMS *Kite,* a revenue cutter, knifed past the breakwater at Cork and sped north as fast as the feather-light breeze would carry her, the crew grimly praying for the poor souls trapped aboard the burning vessel. Presently the smoke was sighted, then the ship itself. But no smuggler ever led the *Kite* such a chase as this one. For hours the trim cutter strained to overtake a "wreck" that appeared to be drifting *against* wind and current.

Only when the *Kite* in desperation fired her forward guns did the smoke-belching will-o'-the-wisp heave to and reveal herself as the *Savannah,* first steamship to cross the Atlantic Ocean.

The *Savannah* was the brainchild of her skipper, young Moses Rogers of New London, Connecticut. It was Rogers who versed himself in the skills of deep-water steam navigation, who wangled $50,000 to buy a hull and a power plant he himself designed, who scoured the waterfront taverns for sailors willing to gamble their lives in his "steam



In 1807, Moses Rogers helped Fulton launch the "Clermont."

STEAM GOES TO SEA

coffin" and who took the helm when the proud little ship—she was 100 feet long — parted from the *Kite* and splashed her way into Kinsale, burning her last lump of coal.

She had come the 3,000 miles from Georgia in 26 days. This was far from a record; the fast packets under ideal conditions could make the crossing in 17 days. Captain Rogers, though, was not trying for speed. Hoarding his fuel and nursing his crude 90-horsepower, one-cylinder engine, he was pleased that the *Savannah* got to Europe in one piece. The sad fact was that her owners had resolved to sell her even before she set forth on her historic voyage and rather hoped never to see her again.

Steamships in 1819 were still a novelty. Twelve years had passed since Fulton's famous *Clermont* proved the potential of steam propulsion in river travel, but the idea of employing steam aboard an ocean-going vessel was looked upon as piling unnecessary risks upon unavoidable ones. The popular view favored a situation in which, if a temperamental boiler blew its seams, the survivors would be within swimming distance of dry land. Fuel was a further consideration. A riverboat could burn wood, but only coal would do for a long voyage, and America's coal came from the English Midlands.

Moses Rogers, however, who had commanded his first ship when he was 21 and who helped Fulton launch the *Clermont,* knew progress was bound soon to catch up with the unspeakably primitive and uncertain facilities then existing for transatlantic travel. Conditions were not markedly better than those endured by Columbus and the Pilgrims. Going to London without first drawing a will was completely unheard of.

Backing for his dream came from a large shipping firm in Savannah, Georgia — Scarsborough and Isaacs, who were looking for ways to build the port's reputation. With their draft in his pocket, Rogers dashed back to New York to buy the unnamed three-master coming off the ways of Fickett's shipyard at Corlear's Hook, a jutting point of land at the foot of Manhattan's Grand Street.

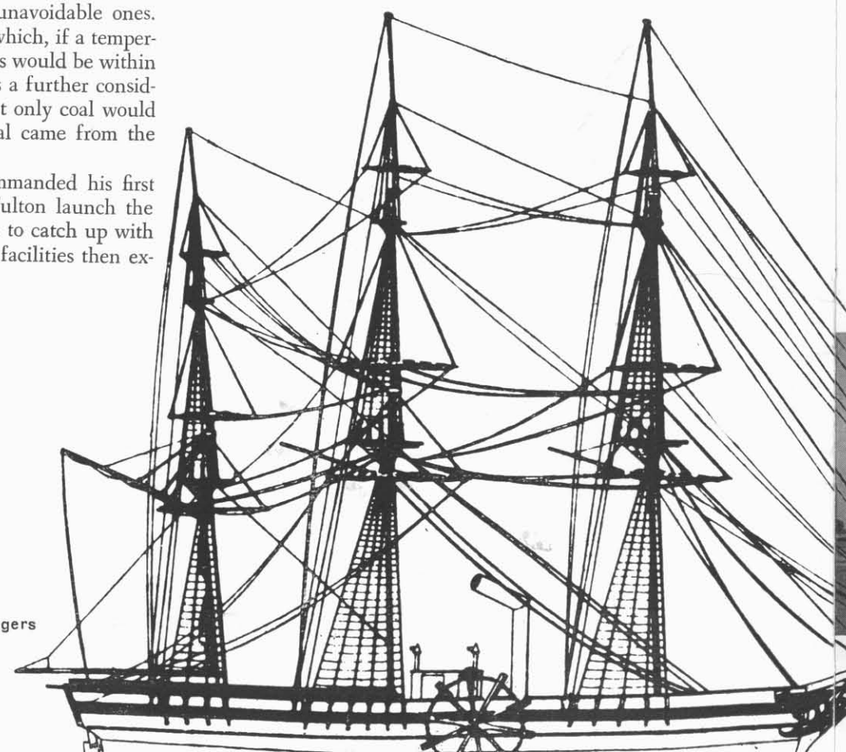
The engine was fashioned at the Speedwell Iron Works, Morristown, New Jersey, at a cost of exactly $3,501.29. It was bolted to the *Savannah's* open deck aft of the foremast, where its direct drive rotated the 25-foot paddlewheels.

Rogers had already learned to his discomfiture that paddlewheels, no matter how stoutly forged, were vulnerable to the lashing of big waves. His pioneering New York-to-Philadelphia run with the *Phoenix,* first steamer to leave protected waters, saw the crew beaching the ship in Barnegat Bay in order to straighten the blade arms twisted by the heavy swell. Thus the *Savannah's* paddlewheels were made retractable. Folding like Japanese paper fans, they could be drawn up on deck if foul weather loomed. Another ingenious feature was the swivel-topped smokestack which could be turned to deflect sparks away from the sails.

The object of the most flattering attention, however, was the interior decor. According to the New York *Mercantile Advertiser* of March 27, 1819, the accommodations were "finished in elegant style and fitted up in the most tasty manner. The cabin for ladies," it went on breathlessly, "is entirely distinct from that intended for gentlemen."

It must be noted with regret that no ladies, or gentlemen either, availed themselves of these princely appointments. Though the *Savannah's* shakedown cruise from New York to Savannah was unblemished by mishap, and though President Monroe himself joined the thousands who came to marvel at her, no paying passengers appeared.

Moses Rogers



An article in a Russian military journal, dated October 14, 1819, and entitled "The American Steamship Savannah," heralded the arrival of the ship in Cronstadt: ". . . this first steamship has indeed aroused the curiosity of all our readers. . . . its deck is 100 feet long and 26 feet wide. Its depth is 15 feet and it sits 12 feet in the water . . . is made to accommodate 22 passengers and carries no cargo, since the combustible used in the steam engine takes up all the space left over from the engine itself and the cabins . . . engine is equivalent to that of 60 horses . . ." The article went on to compliment the scientific achievement of the ship: "Thanks to a new and very clever invention which is yet unknown in Europe, not the slightest salt sediment remains in the boilers although sea water is continuously boiled in them . . . ship makes nine versts per hour . . ." But the Russian Tsar was not in the market for a steamboat as Moses Rogers had hoped.

ВНУТРЕННІЯ ИЗВѢСТІЯ.

Американскій паровой корабль (Steam-ship) *Савання.*

Прибытіе въ Кронштадтъ сего *перваго* парового корабля, безъ сомнѣнія возбудило любопытство всѣхъ нашихъ Читателей. Посему и надѣемся угодить имъ, сообщивъ слѣдующее подробное описаніе онаго, полученное нами отъ одного свѣдущаго наблюдателя.

Помянутый паровой корабль есть прекрасно устроенное и превосходно оснащенное, трехъ-мачтовое судно, въ 300 тоннъ. Палуба онаго имѣетъ въ длину 100, а въ ширину 26 футовъ. Глубина пр[illegible] стирается до 15-ти футовъ, изъ коихъ [illegible] 12-ть находится оный въ водѣ. [illegible] расположенъ для 22-хъ. [illegible] имѣетъ грузу, [illegible] емыя

Furthermore, when on May 22 (now observed as National Maritime Day) Rogers churned past the waving crowds on the banks of the Savannah River and set his course for England, he carried no cargo. The 75 tons of coal and 25 cords of wood to fire the boilers left scant room for a payload. Scarborough and Isaacs had put their city on the map, but as a commercial investment their steamship was an obvious washout. Rogers sailed on the strength of a rumor that Tsar Alexander I of Russia was in the market for a steamship.

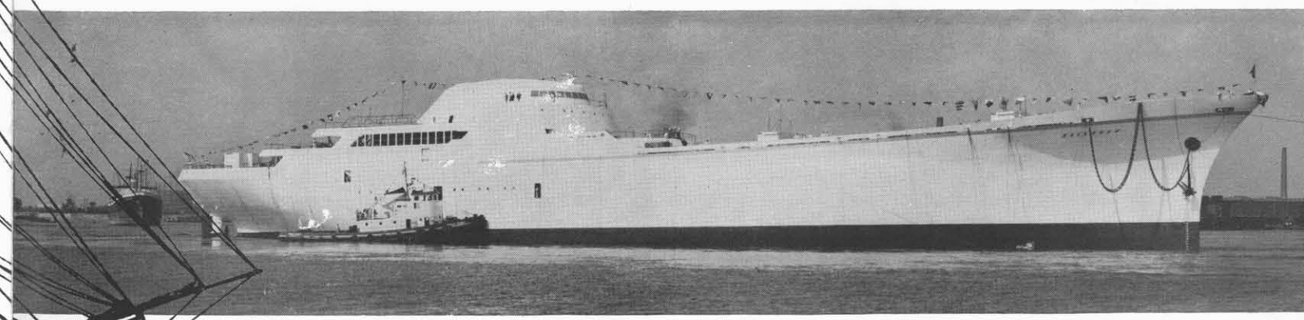
Except for the disinclination of the jointed smokestack to draw and the way the vegetable-oil lubricant broke down into fatty acids and leaked into the boilers, the trip across the ocean was operationally smooth. Much of the time the wind favored use of the sails, but the sight of the *Savannah* with the steam up moved the master of the passing *Pluto* to pen in his log the lyrical appraisal, "The happiest effort of mechanical genius that ever appeared on the western ocean." But, like the *Kite,* other ships were fooled into thinking the *Savannah* was aflame.

At Liverpool, Rogers' first port of call, officials of the Crown tended to be supercilious, but the popular reception was so warm that Rogers had difficulty re-assembling his crew. As for selling the ship, tremendous interest was aroused in mercantile circles, but no one came forward with cash. The story was the same at Copenhagen and Stockholm. The King of Sweden offered to trade $100,000 worth of hemp and iron for the *Savannah,* but Rogers rejected the deal. His hopes were pinned on the Tsar.

The hopes proved hollow. Alexander was cordial but not in a spending mood. Downcast, Rogers headed back to the United States in weather that made heavy demands on his seamanship.

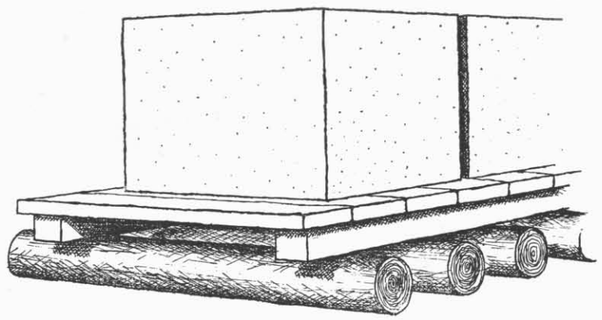
Following a half-hearted effort to unload the *Savannah* on the U.S. Navy, Scarsborough and Isaacs, wiped out by the great fire and yellow fever plague of 1820, put her on the block. The gallant little engine was torn out and sold, the *Savannah* herself placed on routine coastal cargo duty.

In October, 1821, less than two years after carving his niche in maritime history, Moses Rogers died in bed. He was mourned by friends and relatives in the little South Carolina town where he docked his paddle-boat *Pee Dee,* but he was totally ignored by the outside world. Less than three weeks after his funeral, the *Savannah,* namesake of the sleek nuclear-powered merchant ship now under completion, was caught in a gale off Long Island. With her mechanical heart gone and an unfamiliar hand at the helm, she cast herself listlessly on a Fire Island beach and was pounded to splinters by the surf. ■

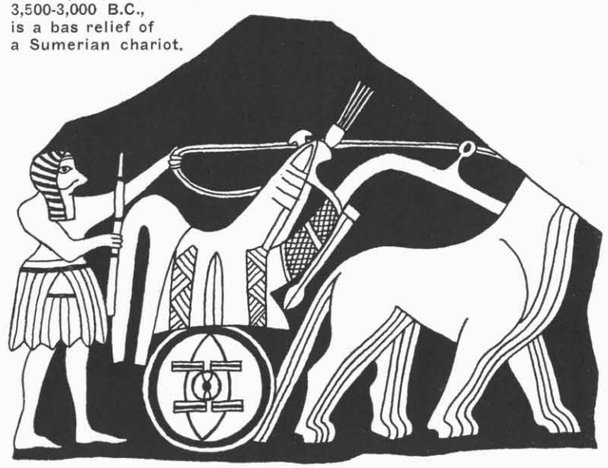


The N.S. (Nuclear Ship) Savannah will give the United States a "first" in nuclear merchant transportation.

Sledges, resting on pre-wheel rollers, carried heavy stone blocks used in ancient structures.



Earliest known wheel picture, 3,500-3,000 B.C., is a bas relief of a Sumerian chariot.



THE BIRTH OF THE WHEEL

MORE than 4,500 years ago, well-to-do Sumerians were wheeling around Ur in donkey-powered carts and chariots. Whether or not their civilization ever reached the point where wives demanded chariots of their own for shopping is not known, but archeologists believe that the Sumerians were among the first to possess wheels and wheeled vehicles.

No one knows exactly when or how the wheel itself was first used, except that one day long ago a perceptive man saw that a disk is capable of turning on a central axis. It's fairly certain that he didn't sit down at that moment and formulate any laws of physics, but his first wheel did just what all wheels since have done: it lessened the friction between an object and the surface beneath it and thereby made it much easier to move the object along. The importance of the wheel's discovery was such that no historian would be far wrong in claiming that the world began moving toward its present civilization on Sumerian wheels.

The Sumerians settled on the Plain of Shinar, near the mouths of the Tigris and Euphrates Rivers, after migrating from the north. The plain is part of what is known as the Fertile Crescent, the northern end of the Arabian Peninsula, which was to cradle such famous cities as Damascus, Nineveh, Babylon, Kish and the earliest of all – Ur.

At Ur, scholars learned much about the Sumerians and what their city must have been like. Remains of their writing system reveal that these amazing people farmed irrigated fields of barley and wheat, used copper for tools and weapons, and traded with far-away peoples in metals, cattle and cloth, as well as developing wheeled vehicles. All of this happened thousands of years before Columbus set sail.

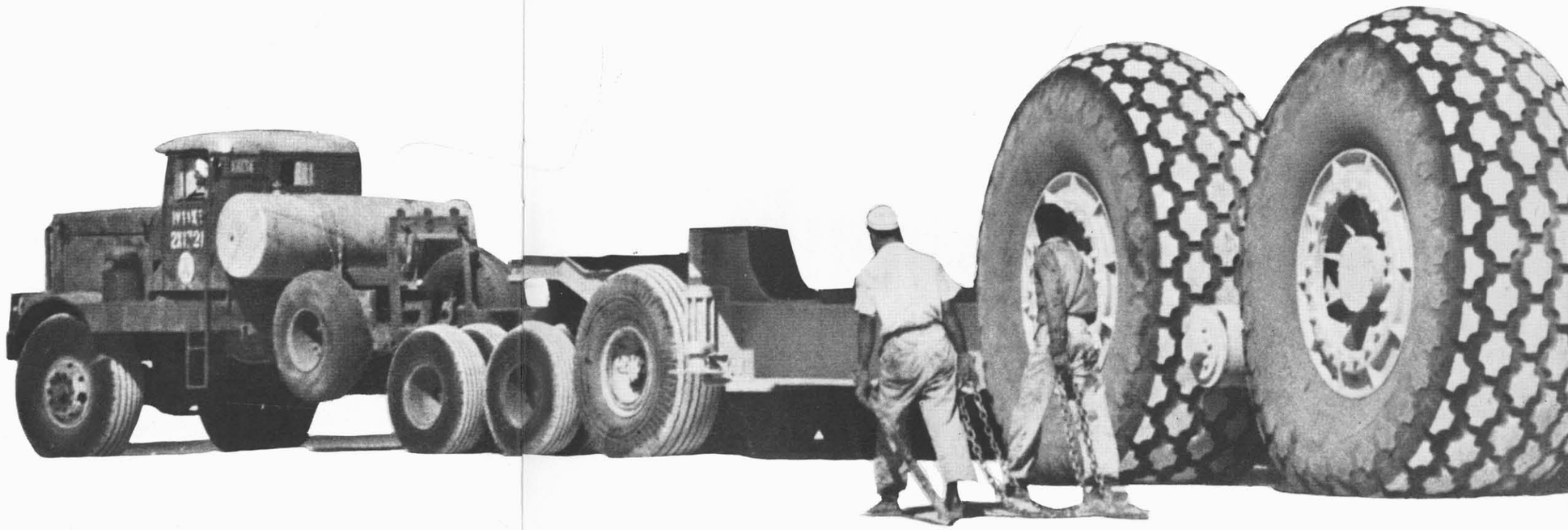
Fragments of ancient cultures indicate that the first wheels were probably developed in logical steps. From rollers or logs, which were very likely the first wheel-like devices, solid wheels evolved, which were little more than chunks of round tree trunks on a fixed axle. After centuries of bumping and wobbling on the massive, solid wheels, the hub and spokes were introduced, making it possible to construct wheels in sections. As wheels turned faster, they wore faster and became lopsided. Metal came into common use to sheath the axle from the grinding wear of wheel action; then "tires" of wood or copper were devised to stand up better under the rigors of travel.

Finer touches were added later. Assyrian wheels were studded with nailheads about 720 B.C., giving the wooden rims a longer life. As men rode further afield, they sought relief from the jounce of their vehicles, and they discovered that the higher the wheel, the easier the ride over rough ground. Although Chaldeans 1500 years before had used four wheels on their war chariots, the Persians of 450 B.C. are credited with the first real four-wheeled carriage. Their *haramaxa* not only distributed the weight of loads better but was also a boon to passenger comfort. The Greeks introduced wheels of bronze, and the Romans, in keeping with their paved city streets and fine road systems, made great progress in improving the wheel.

With the Greeks and Romans came recorded history, and the use of the wheel is thereafter a well-chronicled story of further applications and refinements. In fact, the wheel became so much a part of everyday life that people soon forgot its origin in the Middle East, where a Sumerian put together a contrivance of wood or stone and, finding that it would roll along quite nicely, decided that it might be a handy thing to have around. ■

A war chariot on a 2,500-year-old vase depicts the Greek wheel as lightweight and four-spoked.

Warrior Etruscans from north of Rome helped develop the biga — or two-horse chariot — with its metal-rimmed wheels.



The wheel is still busy in the area where it started rolling. In Saudi Arabia, for example, Aramco's heavy duty trailers ride on 10-foot, low pressure tires.

The mushroom has a past fraught with mystery, romance— and danger

FABULOUS FUNGUS

FOR more than 3,000 years men have looked upon the mushroom as a gastronomical delight, a provider of medicine, a sacred object of worship and a source of deadly poison. And over the centuries, the versatile fungus has filled all these roles.

Scientists estimate that there are somewhere in the neighborhood of 38,000 varieties of mushroom. Of these, more than 700 have proven highly edible. For practical purposes, wild mushrooms break down into several categories: dangerously poisonous, slightly poisonous, disagreeable in taste, edible but of mediocre taste, and those of excellent flavor. Just as their fungus cousins — the blights, rots, rusts and smuts — mushrooms, too, are simple-structured and live off food already prepared by higher forms of plants. The one thing that all fungi lack is the green coloring (chlorophyll) by which green plants, with the sun's help, manufacture their own food (photosynthesis).

The ancient Romans held the little umbrella-shaped plants in such esteem that Juvenal quoted one enthusiast as saying: "Keep your corn, O Libya, unyoke your oxen, provided only that you send us mushrooms!" So highly did Roman epicureans prize this fungus delight that they designed a set of cooking utensils expressly for mushrooms. Mushrooms were regarded as a table delicacy by the Chaldeans of Biblical times, and the Chinese, the Indians and the Japanese gathered them from the fields for their cook-pots. They also learned the science of drying mushrooms whole and of preserving them in the form of powder. For many centuries the peoples of Asia have also used mushrooms as drugs to combat certain diseases and bacterial infection.

The Celtic word for mushroom is translated as "growths of one night." Perhaps because in their wild form (commercially grown mushrooms require three weeks to develop) they can grow with such startling suddenness — covering acres of woodland after a single dew-drenched night — mushrooms once were believed to have been the manna the ancient Hebrews found in the wilderness. But mycologists — the study of *fungi* is called mycology — now understand that ideal weather, wet and hot, can nourish certain mushroom tissue into phenomenally fast growth.

Just as important as current weather to the mushroom is the weather of the preceding year. If it was hot and dry, chances are that the underground part of the fungus where the minute reproductive bodies, the spores, are stored, may dry up or be retarded in functional vitality, making a poor showing the next year.

Commercial growing has eliminated much of this uncertainty. Since the climate of the United States is not favorable to mushroom cultivation out-of-doors and since mushrooms do not need light, they were taken indoors where climate considerations could be kept under exact control. The mushroom was first grown commercially in the western world about 400 years ago in the limestone caves of France, which were hollowed out of the earth when stone to build the city of Paris was quarried. These caves were found to have just the right temperature and high humidity, and until 1900 France had a virtual monopoly in Western mushroom growing. The U.S. and Britain grew almost none.

Shortly before the turn of the century, however, the U.S. Department of Agriculture gave the whole business incentive by providing research information on controlled growing. Greenhouse operators, especially in Pennsylvania, casually started to grow the fungus in unused spaces under benches and tables on their premises. By 1900, mushroom-growing was an industry in Pennsylvania, Delaware and New York.

Only one type of mushroom is cultivated in the United States, an adaptation of the common field variety. But there is almost no limitation of genus, species, color, form or texture amongst the wild mushrooms. In one state alone — Pennsylvania — 1500 kinds of mushroom fungi have been identified. And among them, growing side by side, as colorfully and as attractively, are some of the most lethal sources of poison known to man.

The frightening thing about it is the extreme difficulty of distinguishing between edible and poisonous mushrooms in the early stages of growth. There are no rules known by which an inexperienced mushroom fancier, simply by *looking,* can tell a poisonous mushroom unless someone has already been poisoned by it! Mycologists warn that to be safe, one should be able to recognize the edible species as easily and surely as picking out a violet or a rose. Anyone who is not an expert is strongly advised to do his gathering in a grocery store.

Mushroom grower uses headlamp in dark mushroom house.

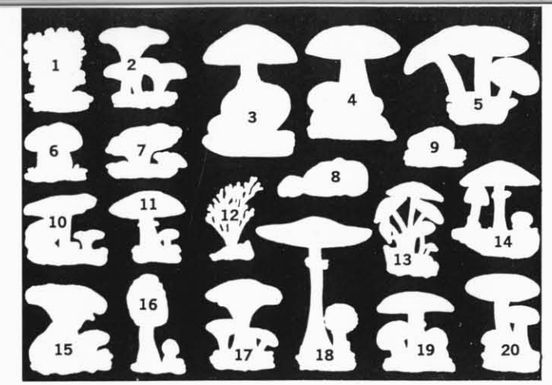
Amanita is the genus to which most poisonous species belong. The Death Cup or Destroying Angel, *amanita phalloides,* with its broadly bell-shaped or oval cap, is the most deadly. It lurks widely distributed in the woods of the United States from spring until late autumn. Its poison strikes the unwary eater much like the venom of a rattlesnake, and there is no known antidote.

The Fly Mushroom, *amanita muscaria,* grows in the woods and along the roadside. It looks attractive enough with its bright yellow, blood red or orange cap. But taken into the human system, it is fatal, for it paralyzes the nerves that control heart action. It was such a mushroom, according to some historians, that finished off Czar Alexis of Russia.

In ancient Rome, Tiberius Caesar was reported to have met his end after sampling a dish of mushrooms. None of this is far-fetched, for such disastrous incidents, repeated many times on the average household level, caused mushrooms to be regarded with fear and suspicion all through the Middle Ages. Dark tales, spread from serf to serf and from master to master, related that the mushroom or toadstool, as it came to be called, was the haunt of night creatures who were set on doing mischief to humans. In Shakespeare's day, a cook-book writer put it all in a nutshell when he declared: "There be two kinds of musherons; one that sleeth and one that doth not."

Gradually, as early students of botany managed to distinguish the good mushrooms from the bad, the tasty fungus regained its former place in the gourmet's esteem. It has now become more than a mere condiment at a gourmet's table. Cookbooks today recognize it as a food, containing plenty of minerals, a fair amount of vegetable protein and the essential vitamins. The fascinating fungus plays an important role in the European diet, especially that of the French, German and Swiss. And during a food shortage in Austria after World War II, exhibitions were staged and pamphlets written to encourage everyone to eat mushrooms and so replace deficiencies in their diet. It is said to be the chief food of the natives of Tierra del Fuego, off the lower tip of South America, and the dwellers in some interior parts of the Americas virtually live off the plant.

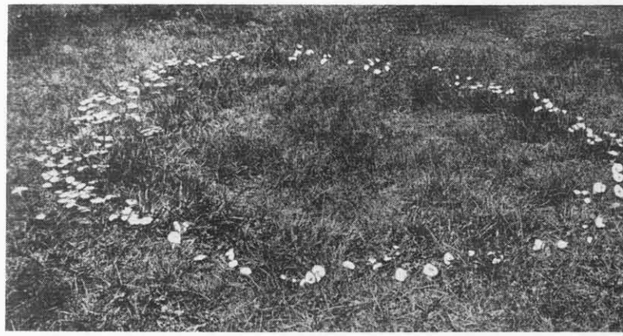
Some mushrooms have an ethereal, luminous quality at night, and this may explain the supernatural powers peoples all over the world have attributed to the plant for centuries. An ancient druid writer in Gaul reverently describes the sacred *amanita* as a golden fungus growing more than a foot tall and glowing with a luminosity that lit up the shadowy woodland. One present day Australian species is said to throw off such a clear, emerald-green light that it can be read by. Here at home, *Clitocybe illudens,* known



MUSHROOM COVER: KEY

1. Helvella esculenta: springtime, found under aspen and pine, edible. **2. Cantharellus aurantiacus** ("The False Chantrelle"): found in woods, questionable. **3. Amanita muscaria** ("The Fly Mushroom"): throughout conifer areas, poisonous. **4. Boletus edulis** ("The Edible Bolete"): woods, open places, late summer and fall, edible. **5. Russula emetica:** poisonous. **6. Boletus pachypus** ("The Thick-Footed Bolete"): questionable. **7. Hydnum repandum** ("The Hedgehog Mushroom"): Eastern United States, Rocky Mountains, West Coast, hardwood and conifer forests, edible. **8. Tuber melanosporum** ("The True Truffle"): Europe (France, Italy), edible. **9. Scleroderma aurantiacum** ("The Golden Scleroderma"): found in rotted wood and humus, not palatable. **10. Cantharellus cibarius:** hardwood, conifer forests in summer and fall, edible. **11. Boletus luteus** ("The Yellow-Ringed Bolete"): under pines, edible. **12. Calocera viscosa** ("The Little Horn Mushroom"): rotting wood, nonedible. **13. Naematoloma fasciculare** ("The Clustered Mushroom"): in decaying logs, questionable. **14. Amanita phalloides** ("The Death-Cup Mushroom"): poisonous. **15. Lactarius deliciosus** ("The Delicious Milk Fungus"): forests, edible. **16. Morchella esculenta** ("The Sponge or May Mushroom" also known as "The True Morel"): abundant during the last two weeks in May in woods and meadows, edible. **17. Clitopilus prunulus** ("The Plum Mushroom"): found on old tree trunks in woods, edible. **18. Lepiota procerus** ("The Parasol Mushroom"): edges of woods, pastures, edible. **19. Agaricus campestris** ("The Meadow Mushroom" or "Field Mushroom"): cultivated commercially, found in meadows and lawns, edible. **20. Boletus scaber** ("The Rough-Stemmed Bolete"): edible.

Poisonous Clitocybe illudens, Jack-O'-Lantern, is luminous.



Mushrooms growing in rough circles are called Fairy Rings.