

Bones of Stones

Fossils are evidence of plants and animals that lived long ago preserved in rocks. The layer of rock in which a particular fossil is found tells you something about the age of the fossil and about the animal or plant itself, the climate, and the environment in which the plant or animal lived.



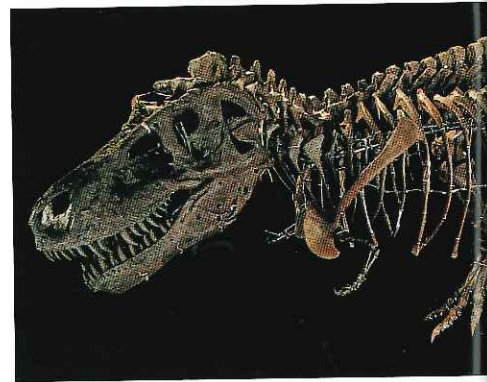
▲ **BRITISH SCIENTIST**
Sir Charles Lyell is considered the father of modern geology, the study of the physical and chemical nature of Earth. In the 1830s, Lyell proved that the

planet had changed slowly and gradually in the past, just as it is still doing today. This idea was shocking to many people, who believed that sudden disasters, such as earthquakes, mudslides, and so forth, quickly shaped the mountains and other features of Earth. Also, contradicting the common belief that Earth was a few thousand years old, Lyell showed that it was billions of years old.



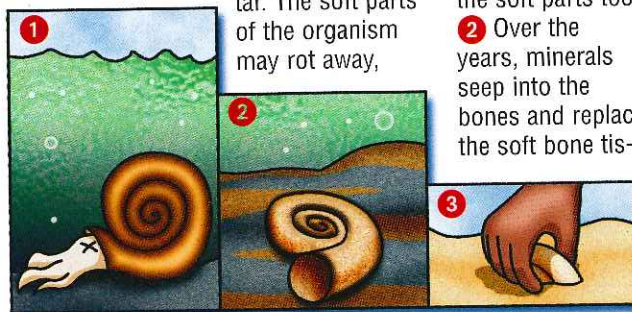
▲ **THE GRAND**
Canyon, one of the most popular national parks in the U.S., is a kind of time machine. Movement of Earth's plates, erosion by wind and water, and the action of the Colorado River have dug a hole

more than one mile deep and 18 miles wide. This hole has exposed rock layers and fossils all in one place. Scientists believe that in the deepest part of the canyon the rock layers date back two billion years.



How Fossils Form

MOST PLANTS AND animals die and rot without leaving a trace. But conditions can occur that preserve a creature or its hard parts. Here is the main way fossils form.



1 An animal dies. Its remains are quickly covered with mud, wet sand, ice, or tar. The soft parts of the organism may rot away,

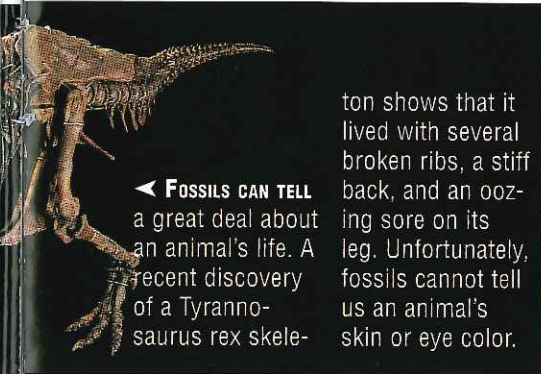
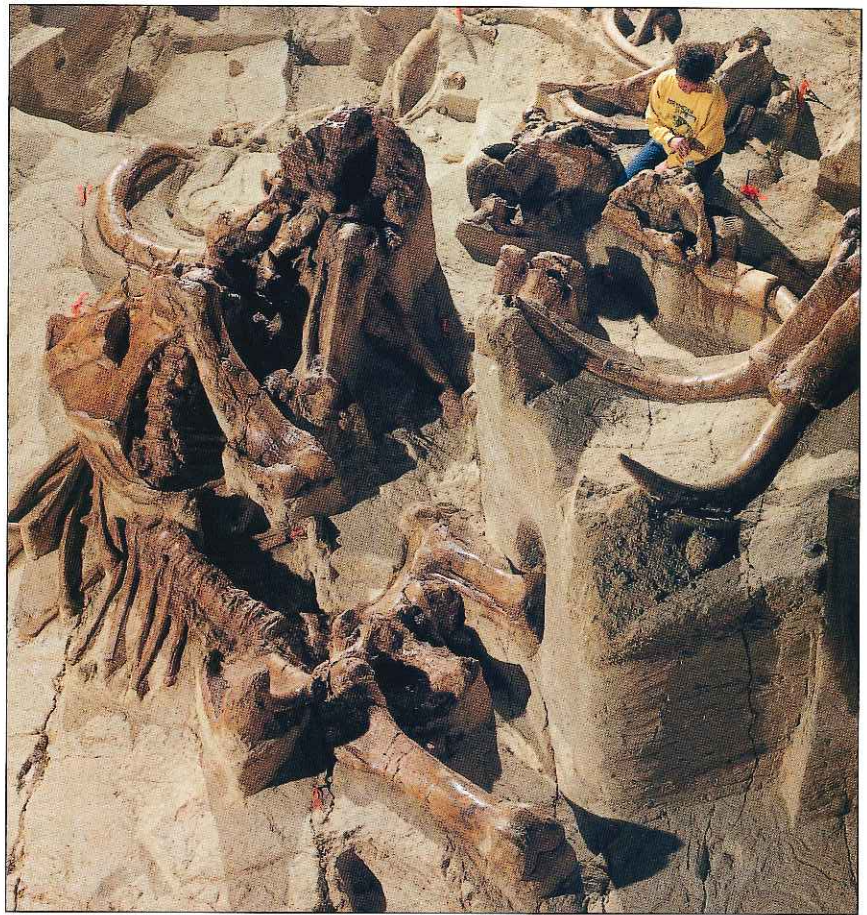
leaving bones, teeth, scales, and so forth—although tar and ice will preserve the soft parts too.
2 Over the years, minerals seep into the bones and replace the soft bone tis-

sues. The bones are turned into rock.

3 Earthquakes, erosion, and other natural events lift the fossil to the surface, where it is discovered.

► **DR. JAMES**
Hagadorn came upon an unusual find—jellyfish fossils. The circular impressions were left in 500-million-year-old sandstone! The reason the find

An Unusual Find Jellyfish Fossils



◀ **FOSSILS CAN TELL** a great deal about an animal's life. A recent discovery of a *Tyrannosaurus rex* skele-

ton shows that it lived with several broken ribs, a stiff back, and an oozing sore on its leg. Unfortunately, fossils cannot tell us an animal's skin or eye color.

▲ **THE WESTERN** U.S. is a prime place where paleontologists find fossils. The region contains vast amounts of sandstone, a type of sedimentary rock in which animal bones become fossilized. Some

fossils are buried in loose sand that can be swept away with a brush. Other fossils have to be blasted out of the sandstone with a jackhammer.

► **AT LEAST 3.5** million years ago, hominids—early humans—walked across a field of volcanic dust in what is now Tanzania. The dust hardened into rock, preserving the tracks. One of the walkers was about 4 feet 9 inches tall, and the other was about 4 feet 1 inch tall. A child's footprints can be found within the larger tracks.

CHECK IT OUT!
What kind of fossil is this?
(answer on back cover)



is so unusual is that jellyfish have no bony parts, and if they are stranded on the beach, they are usually eaten by predators. These jellyfish must have been covered by sand soon after they came ashore.

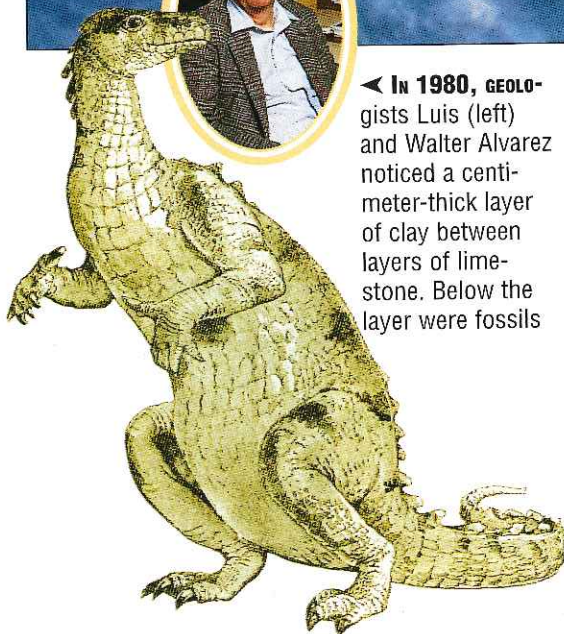


Catch a Falling Star

About 65 million years ago, a space rock the size of Mount Everest slammed into what is now Mexico's east coast. The object exploded with 10,000 times the force of all of today's known nuclear weapons combined. Any creature within a thousand miles of the blast died instantly. A cloud of dust encircled Earth and blotted out the sun. Within weeks, any animal larger than a medium-size dog was dead.

That impact, according to most scientists, is how the dinosaurs became extinct. The theory is still debated, but there is no doubt that big objects do hit our planet. Each year, about 10,000 tons of space debris rain on us. Most comes in the form of dust or small rocks. But every so often, something really big comes "screaming" towards Earth.

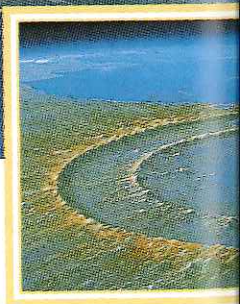
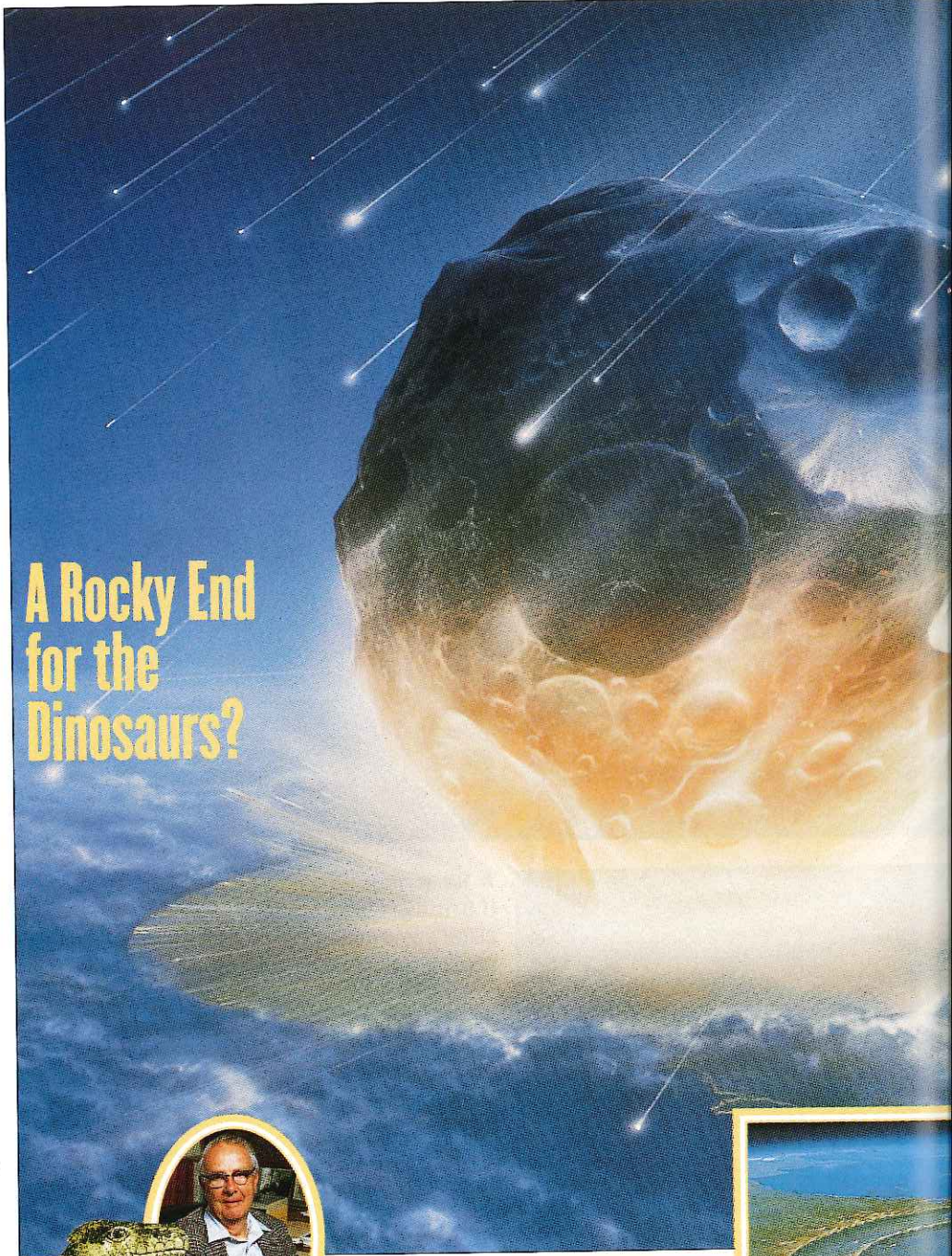
A Rocky End for the Dinosaurs?



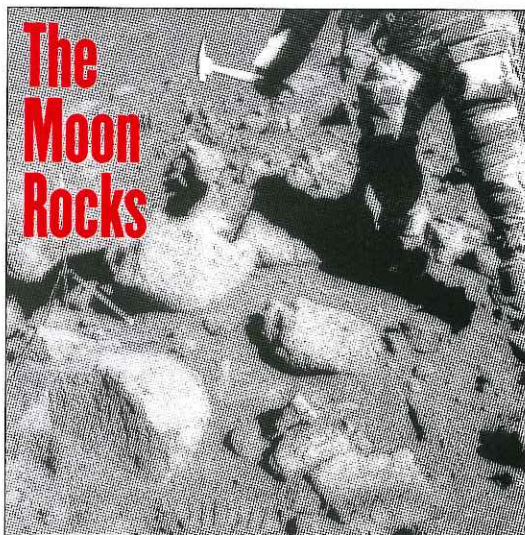
◀ **IN 1980**, GEOLOGISTS Luis (left) and Walter Alvarez noticed a centimeter-thick layer of clay between layers of limestone. Below the layer were fossils

from the age of dinosaurs. Right above it, there were almost no fossils at all. The clay layer contained the element iridium, common in meteorites but not common on Earth. This led the Alvarazes to believe a comet or asteroid had hit Earth and its impact had killed off the dinosaurs.

▲ **AT FIRST**, FEW scientists agreed with the Alvarazes' theory. Then, in 1990, geologists looking for oil off Mexico's coast, discovered a huge impact crater buried under a



The Moon Rocks



ASTRONAUTS FROM the Apollo moon landings brought back 842 pounds of moon rocks and soil. These samples helped settle a debate about how the moon was formed. Scientists now believe that a giant rock, the size of Mars, crashed into the newly forming Earth. The heavier elements of the giant, impacted rock stayed embedded on Earth. The splashed molten rock that was ejected into orbit about the Earth finally coalesced into the moon.



Lunar rocks in the Apollo 11 sample container



Microphotograph of rock collected from Apollo 12



Fragments found in the moon's "orange soil" by Apollo 17

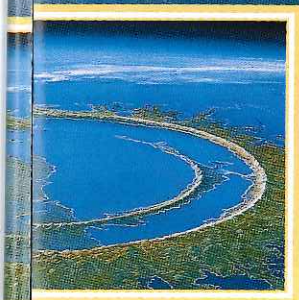
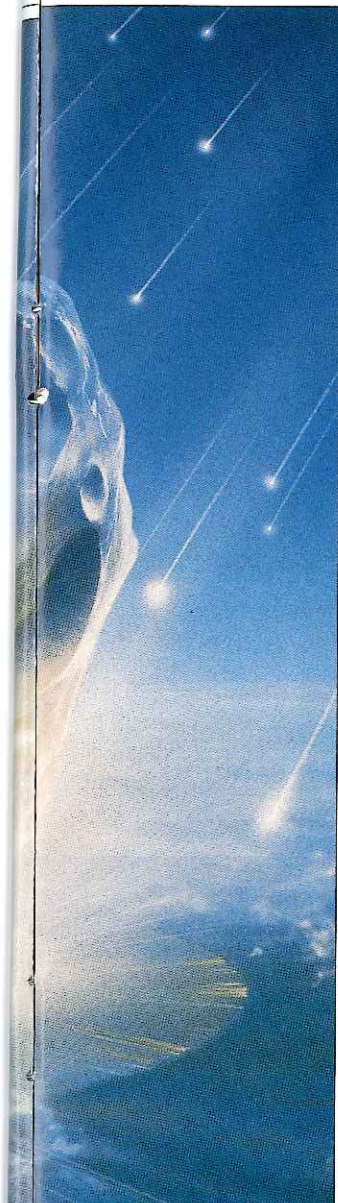
▼ **EARTH WOULD** have craters just like the moon if it didn't have an atmosphere, which is responsible for climate and weather. Rain and wind erode old craters. Plants and water cover up old craters, and

natural disasters cause changes. Canyon Diablo in Arizona (below) is a rare case of a giant impact crater surviving relatively intact. A 15,000-ton meteorite crashed there about 50,000 years ago.



▲ **METEORITES** usually burn up in the atmosphere before hitting Earth. Most that make it to Earth are small or break up on impact. The 15½-ton Willamette meteorite, which landed in Oregon, is the biggest ever found in the U.S. Scientists think it was the iron core of a planet that broke up billions of years ago. The largest meteorite in the world is the 60-ton Hoba meteorite in Namibia (above).

► **METEORITES MAY** contain metallic iron, which makes them denser and heavier than Earth rocks. Some meteorites are unlike any Earth rock, while others may contain the same minerals found on Earth but welded together with an iron alloy. A few meteorites look like Earth rocks. To identify them, scientists look for traces of the lighter elements that are missing from Earth rocks.



mile of limestone. Underground imaging equipment showed that the crater was exactly the right size and formed at exactly the right time to fit the Alvarezes' theory.



▲ **COULD ANOTHER** large object hit Earth? In 1908, a rocky object exploded in Western Siberia with the force of several

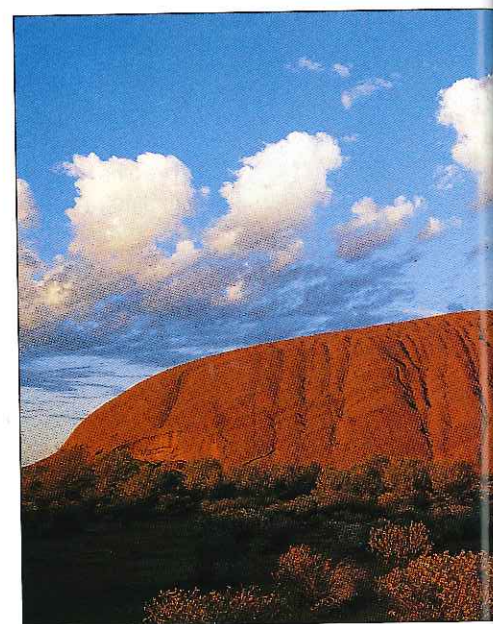
nuclear bombs. No one was killed in that sparsely settled place. But the explosion leveled trees in an area the size of New York City.



Rock Stars

Every year, nearly two million visitors travel to South Dakota to view Mount Rushmore. For 14 years, sculptor Gutzon Borglum and nearly four hundred workers carved into the granite mountain 600-foot-high portraits of four U.S. presidents: George Washington, Thomas Jefferson, Theodore Roosevelt, and Abraham Lincoln (left). Like so many famous rocks and rock formations, Mount Rushmore captures people's imagination.

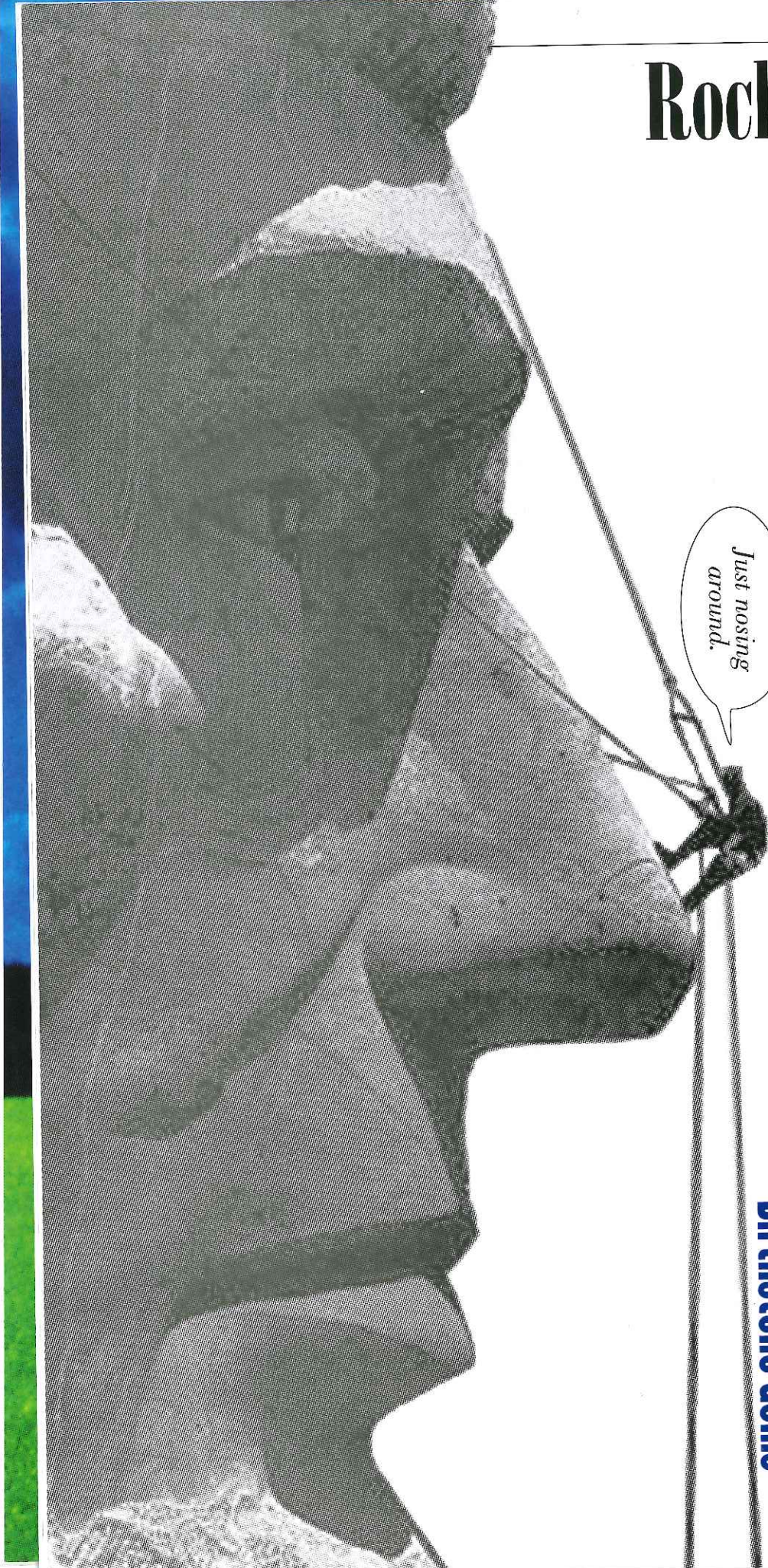
*Just nosing
around.*

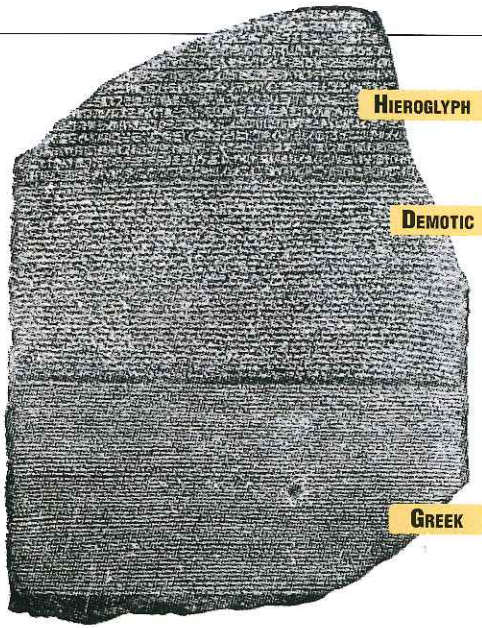


Birthstone Gems

► **FOR GOOD LUCK,** many people wear their birthstone—a gem that represents the month in which they were born. The practice started around the first century A.D. It was probably inspired by the biblical

story of Aaron, the Israelites' first high priest. His breastplate was decorated with 12 precious stones. Different cultures and times have used different birthstones for the months.





HIEROGLYPH

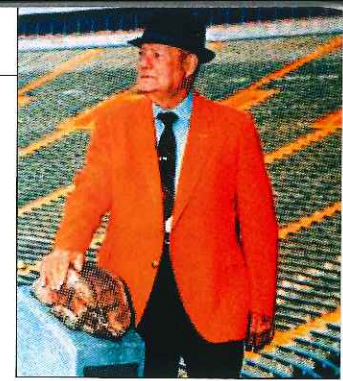
DEMOTIC

GREEK

◀ **IN 1799**, while digging a foundation for a new fort, French soldiers stumbled upon a large piece of black basalt, an igneous rock, near the Egyptian town of el-Rashid, or Rosetta. It contained a royal decree, from around the year 200 B.C., written in three different languages. One version was written in ancient Egyptian hieroglyphs—a language used for nearly 3,500

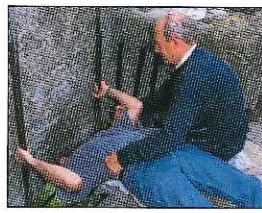
years and then forgotten. Another version was written in Greek. The third version was Demotic, a streamlined kind of Egyptian writing. Scholars used the Greek to translate the hieroglyphs. The Rosetta Stone brought the dead language of the pharaohs back to life.

▼ **EACH YEAR**, millions of Muslims make a pilgrimage to Mecca in Saudi Arabia. Mecca is home to the Kaaba, the holiest place in the Muslim world. In the southeast corner of the cube-shaped Kaaba lies the Black Stone, which pilgrims kiss or gesture toward. It may be a meteorite.



▲ **BEFORE EACH HOME** football game at Clemson University in South Carolina, players rub Howard's Rock for good luck. Head coach Frank Howard (above) began the tradition in 1966. That year the Tigers came from an 18-point deficit to defeat Virginia 40–35, and thus a tradition was born.

► **IT'S BEEN SAID** that if you kiss the Blarney Stone at Blarney Castle in Ireland, you get the gift of gab!



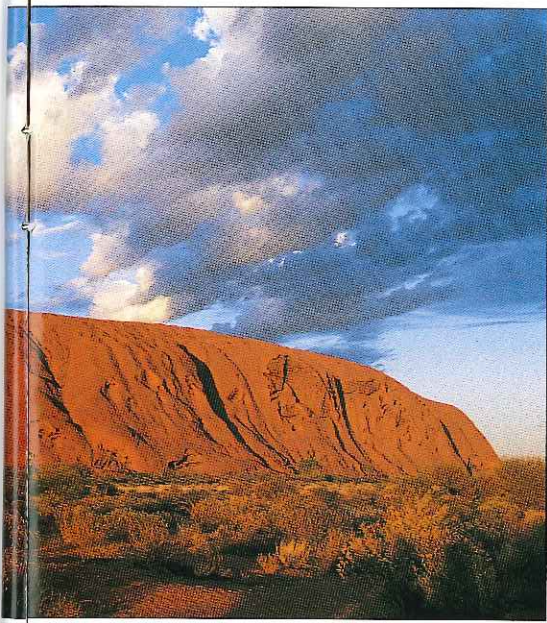
◀ **THE WORLD'S** biggest rock is Australia's Uluru, also known as Ayer's Rock. More than two miles long and one mile wide, this landmark is famous for the way the coarse arkosic sandstone (containing feldspar) changes color at sunrise and sunset. Uluru is owned by local Aboriginals and contains several sites they consider sacred.



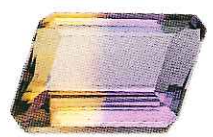
▲ **NOT ALL ROCK** formations are above ground. New Mexico's Carlsbad Caverns began forming just before the time of the dino-

saur. Over millions of years, natural acids in water ate away at cracks in the underground limestone structure. The limestone

was eroded, and cave-ins helped form giant underground chambers. One is called the Big Room. It's 25 stories high and a third of a mile wide.



JANUARY: GARNET



FEBRUARY: AMETHYST



MARCH: AQUAMARINE



APRIL: DIAMOND



MAY: EMERALD



JUNE: PEARL



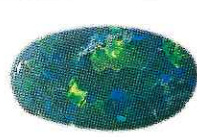
JULY: RUBY



AUGUST: PERIDOT



SEPTEMBER: SAPPHIRE



OCTOBER: OPAL



NOVEMBER: TOPAZ



DECEMBER: TURQUOISE

Caves often have long columns of rock called stalactites and stalagmites. What is the difference? (answer on back cover)

CHECK IT OUT!

BUGS FROM ROCKS

Did you know that rocks can be turned into bugs? Here's how to make bug knick-knacks, paperweights, or doorstops, depending on the size of the rocks you have.

1

Collect smooth flat rocks of all sizes. Small ones can be knick-knacks, larger ones can be paperweights, and very large ones can be doorstops.



2

Wash the rocks in warm, soapy water, rinse, and dry thoroughly. If the rocks come from the beach, soak them, rinse, and soak again to get rid of the salt.



3

Use acrylic paints to make realistic or fanciful bugs on the stones. If you want, you can paint the rocks with white water-based paint and let them dry before painting on your bug design.



4

Instead of painting eyes, you can glue on wiggle eyes.



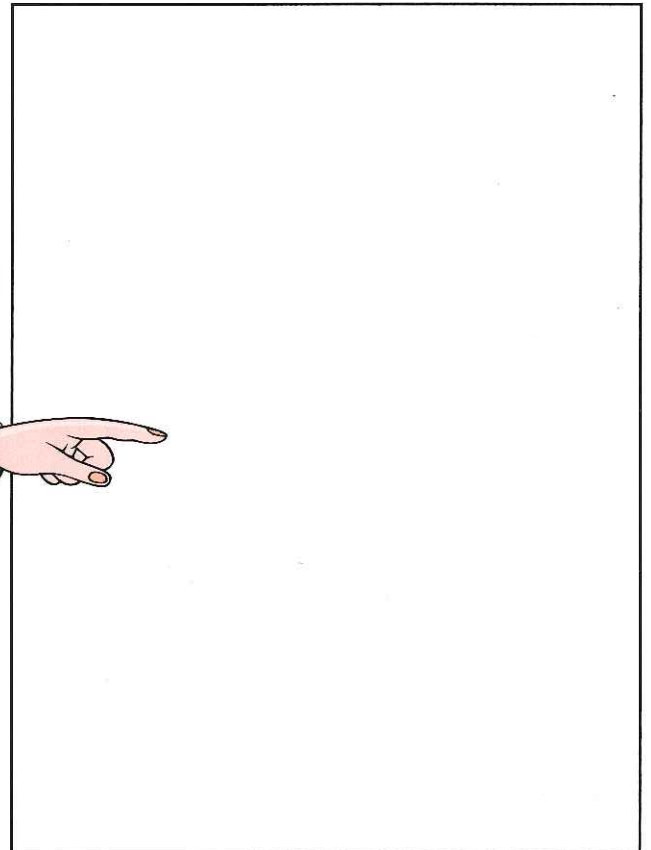
5

To protect the paint, cover it with a coat of clear varnish.



BE A JEWELER

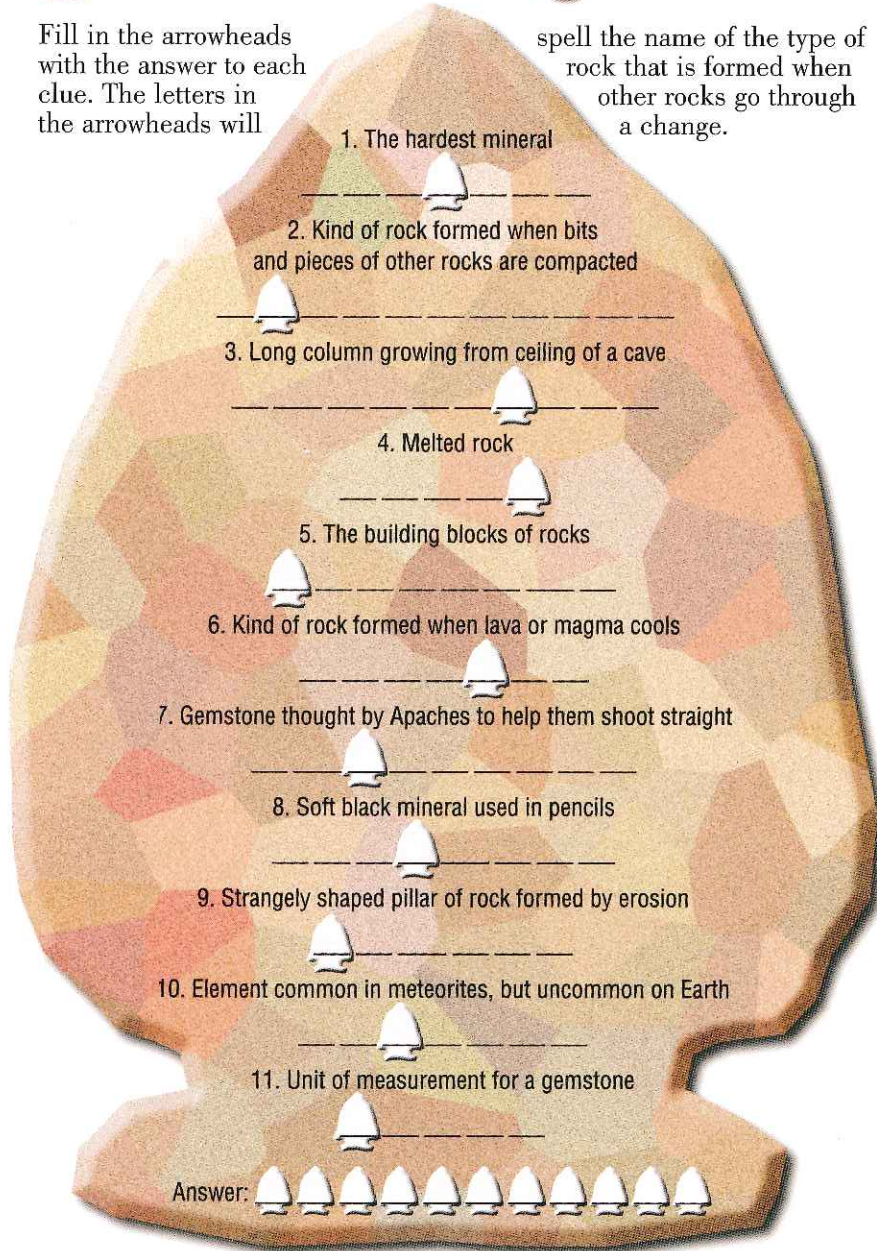
Imagine you had an unlimited supply of beautiful gemstones. What would you make with them? Would you make a necklace, a watchband, a pin, a jewel-encrusted goblet? Be a jeweler, and design a beautiful object. Use crayons or markers to color your design.



Arrowhead Acrostic

Fill in the arrowheads with the answer to each clue. The letters in the arrowheads will

spell the name of the type of rock that is formed when other rocks go through a change.



MORE ON ROCKS

BOOKS FOR CHILDREN

- ☛ Mary Barnes, *The Ultimate Asteroid Book: The Inside Story on the Threat from the Skies*, Aladdin Paperbacks, 1998.
- ☛ Alan M. Cvancara, *A Field Manual for the Amateur Geologist*, John Wiley & Son, 1995.
- ☛ Cyril Walker and David Ward, *Eyewitness Handbooks: Fossils*, Dorling Kindersley, 1992.
- ☛ R.F. Symes, *Eyewitness: Rocks and Minerals*, Dorling Kindersley, 1988.

BOOKS FOR ADULTS

- ☛ A.C. Bishop, A.R. Wolley and W.R. Hamilton, *Cambridge Guide to Minerals, Rocks, and Fossils*, Cambridge University Press, 1999.
- ☛ Arthur B. Busbey III, Robert R. Coenraads, Paul Willis, and David Roots, *The Nature Company Guides: Rocks & Fossils*, The Nature Company and Time-Life Books.
- ☛ Dougal Dixon, *The Practical Geologist*, Fireside, 1992.

VIDEOS

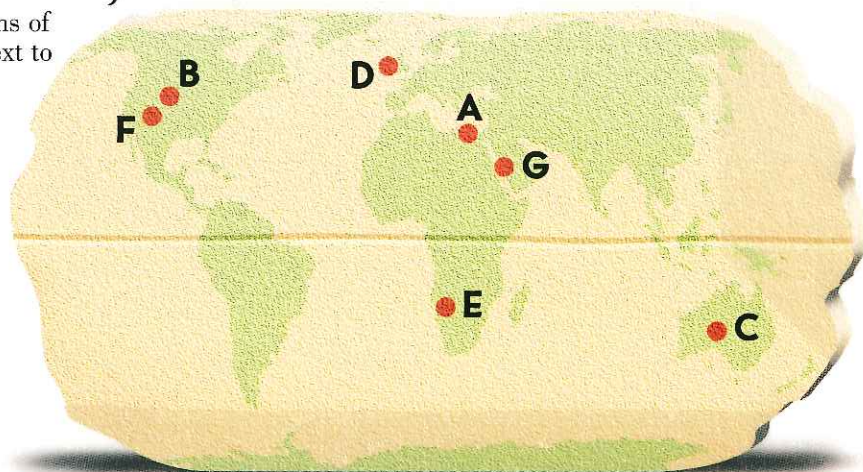
- ☛ *Rocks & Minerals*, produced by Dorling Kindersley, 1996.
- ☛ *Splendid Stones*, produced by National Geographic, 1991.

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Famous Rocks Are Everywhere

The letters on the map show the locations of some famous rocks. Write each letter next to the name of the correct rock.

- _____ 1. Blarney Stone
- _____ 2. Black Stone
- _____ 3. Carlsbad Caverns
- _____ 4. Rosetta Stone (discovered)
- _____ 5. Uluru
- _____ 6. Mt. Rushmore
- _____ 7. Hoba meteorite



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ANSWERS:

PAGE 5: What are these? A strangely shaped natural pillar of rock is called a hoodoo. Hoodoos are shaped by erosion caused by wind and rain. **PAGE 7:** Are pencil leads made out of lead? No, the "leads" are made from a mixture of clay and graphite. Graphite is a soft, black greasy mineral composed of carbon. **PAGE 9:** Why do women wear diamond engagement rings on their "ring finger"? The custom springs from two superstitions. First, many ancient people believed the heart was the seat of the emotions, especially love, and that it was on the left side of the body. (The heart lies between the lungs at the center of the chest.) Second, Egyptians believed that the finger next to the pinkie of the left hand had a vein running straight from it to the heart. **PAGE 13:** What kind of fossil is this? It is not a fossil at all but a mineral form called a dendrite. These slender, fernlike or plantlike crystals tend to form at the joints of rocks. **PAGE 17:** What is the difference? Stalactites look like icicles hanging from the roof. Most occur when ground water dissolves the mineral calcite from limestone. With each drip, a tiny amount of calcite gets left behind. Over thousands of years, the stalactite forms. Stalagmites come up from the floor but form the same way—through slow drips of mineral-rich water. To tell stalactites and stalagmites apart, remember that stalactites (with a c) are on the ceiling; stalagmites (with a g) are on the ground.



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ON THE COVER: Pinnacles Desert, Western Australia, Pete Turner

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ANSWERS: PAGE 19: ARROWHEAD ACROSTIC: 1. diamond; 2. sedimentary; 3. stalactite; 4. magma; 5. minerals; 6. igneous; 7. turquoise; 8. graphite; 9. hoodoo; 10. iridium; 11. carat. **METAMORPHIC. FAMOUS ROCKS ARE EVERYWHERE.** 1. D; 2. G; 3. F; 4. A; 5. C; 6. B; 7. E.

ORIGINAL ILLUSTRATIONS:

Acme Design Company: Rock Cycle, p.2; Earth's Layers, p.4; Photographic Film, p.7; Mohs Scale, p.8; Famous Rocks, p.19. Michael Kline Illustration: Cartoons, cover, p.2, p.8, p.15; Earth's Major Tectonic Plates, p.4; It's not my fault, p.5; How Fossils Form, p.12; Bugs from Rocks, Be a Jeweler, p.18; Arrowhead Acrostic, p.19.

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