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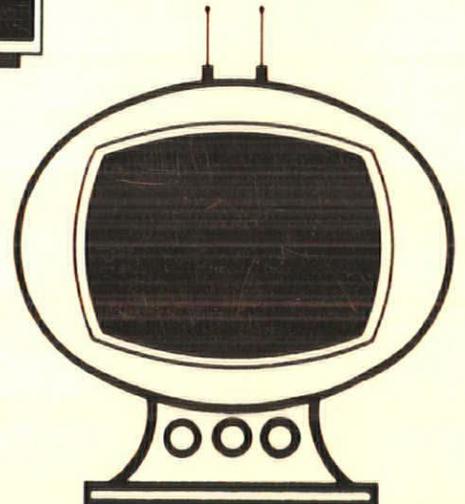
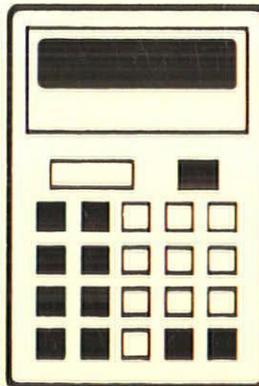
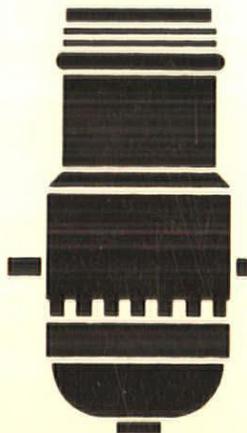
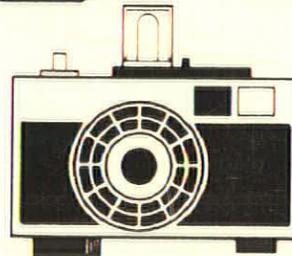
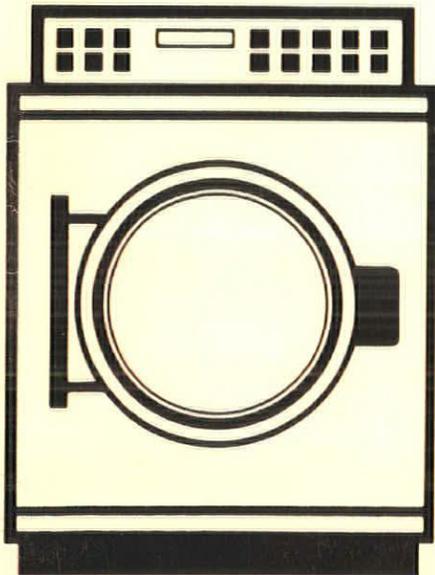
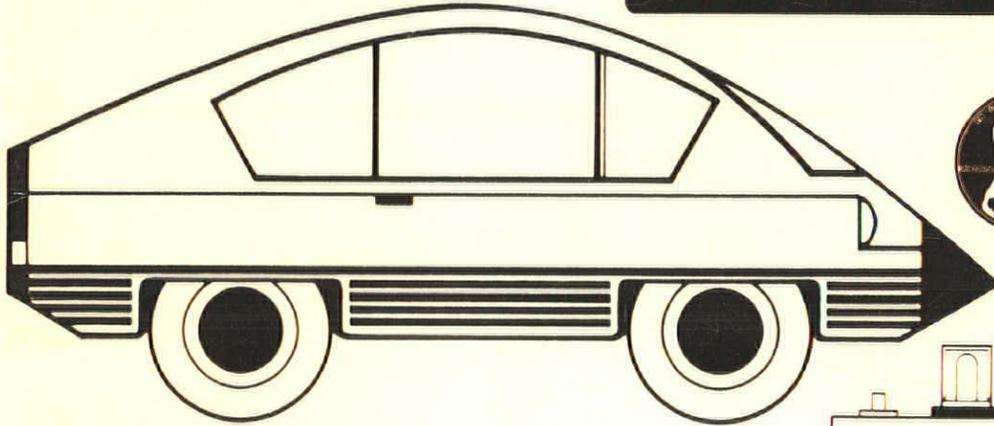
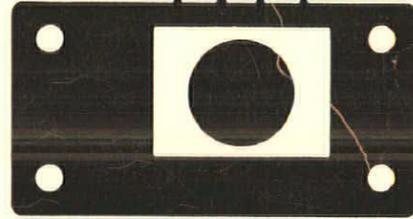
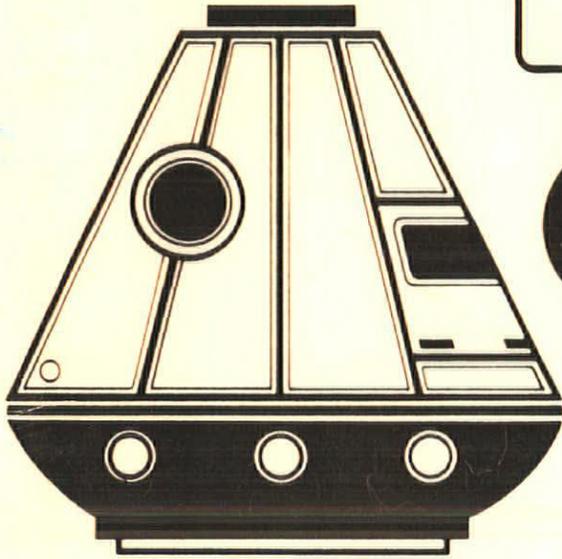
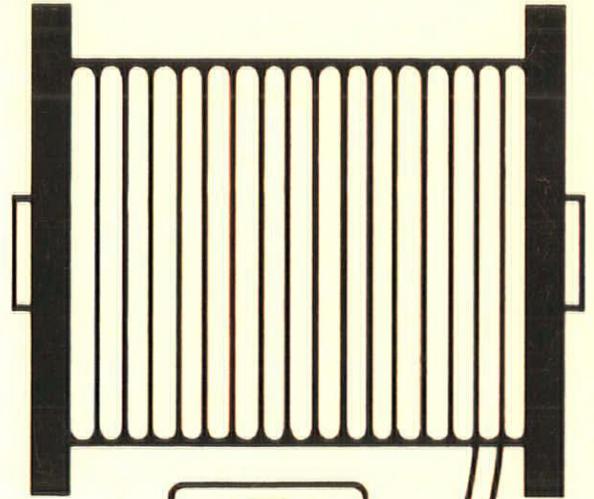
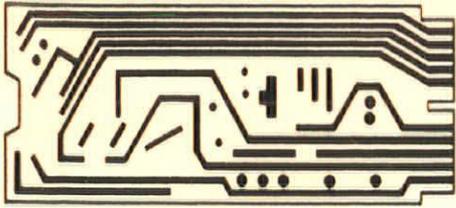
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# ARIZONA'S COPPER



**Physical Properties of Copper**

Symbol – Cu... Atomic Weight – 63.54

Specific Gravity – 8.96

Melting Point – 1981.4° F.

Boiling Point – 4700° F.

Electrical Resistivity – Microhm-cm – 1.673

Tensile Strength – H.D. – 60,000 pounds per  
square inch (annealed 30,000)

Crystal Structure – Face-centered cubic

Valence – one and two

## The day you did without copper.

These are some of the things you did without, the day you did without copper:

You had no lights.

No telephone.

No television.

No radio.

No shower.

No refrigerator.

No toaster.

No cooling.

No paper.

No change.

No car.

And no door knob.

Which didn't matter. You had no door keys, either.

Because this was the day you did without copper.

Every single one of those things is made with the eternal

metal, or relies heavily on it, or won't work without it.

Keys and cars and coins and coolers can't cut it these days without copper. It's one non-precious metal we'd have a hard time replacing.

For one thing, almost everything that runs with electricity relies on copper. Water pipes get their long lives from copper. The rivets on your jeans are rustless copper. Copper is sandwiched into our coins. The sturdiest keys — and locks made to last — come from brass, a stout copper alloy.

But copper's a bashful servant. Keeps pretty much behind the scenes. Yet even though you don't see too much of it, you can't do much without it. In fact, it's a safe bet you're using some right now. Wherever you are.

Here.

Or landing on the moon or Mars.

Copper.

It's man's eternal metal.

Man's most versatile metal.

Man's most durable metal.

And there's one state that mines more of this jack-of-all-trades metal than the other 49 lumped together.

Arizona!

## Man's oldest metal.

Arizona produces more copper than any state in the nation. We're big in copper. But we're just newcomers in the business.

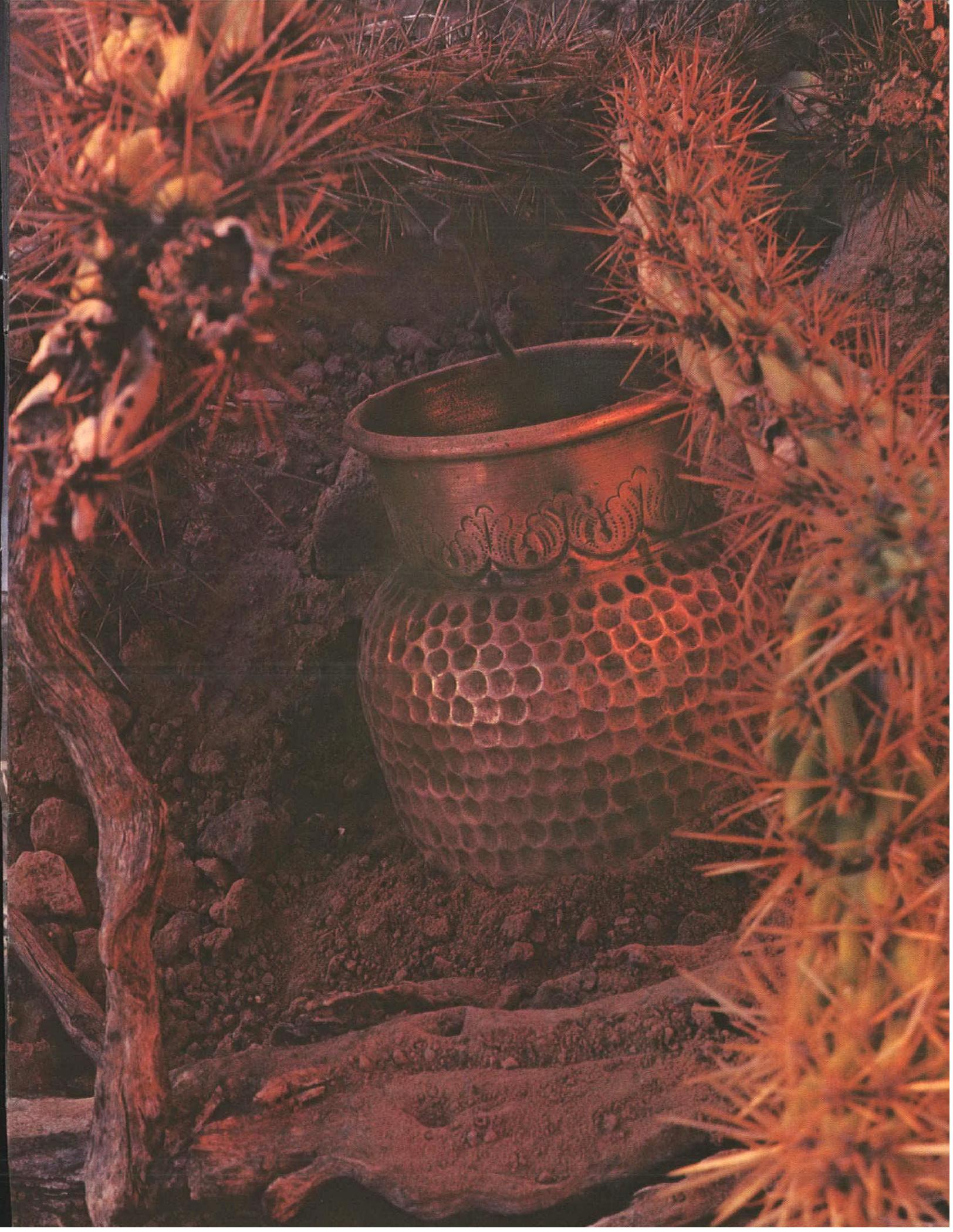
Although copper has been on earth for millions of years, man has been using it only since roughly 8000 B.C. The day a wandering hunter in the Tigris and Euphrates river valleys stumbled across some native copper and figured out how to pound it into shape, he'd found more than just a way of making himself a better arrowhead.

He'd found man's first metal. Copper was here to stay.

### **What's good enough for the pharaoh.**

And that was true in more ways than one. We've been using the versatile metal ever since. And we've found out that *products* made from copper are here to stay, too.

Example: The Egyptian Pharaoh, Cheops, had some copper pipes installed in his bath. Dug up 50 centuries later, they were still good for carrying water. Things made of copper are made to last!



## Coronado missed the boat.

Man has used copper over the ages. Weapons, jewelry, coinage, tools were made from it. The hulls of boats were sheathed with it – including Columbus' Santa Maria. The mound-building Indians of Ohio buried their dead with imperishable noses of copper.

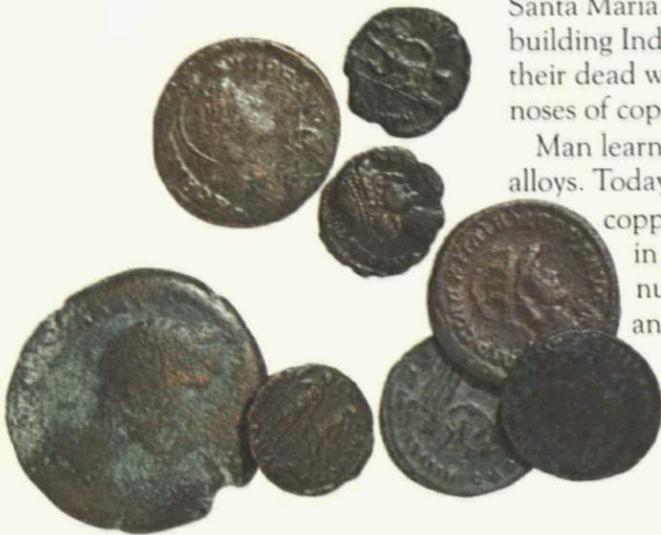
Man learned early to make alloys. Today these mixtures of copper and other metals in various proportions number over 200, and they're used for

everything from lipstick cases to ships' propellers. Bronze made lasting statuary. Brass was as tough as its name. Even Goliath wore a helmet of brass.

Copper was a valuable commodity for centuries. But when Coronado marched north out of Mexico in 1540 A.D., it wasn't the red metal he had on his mind. He was looking for gold.

He never found it. But he did walk right over fabulous deposits of copper. And, weary months later, walked right back over them again.

So, as they had for centuries, only the native Indians made any use of Arizona's copper.





## Arizona, biggest copper state in the union.

It would be another three centuries before copper really put Arizona on the map.

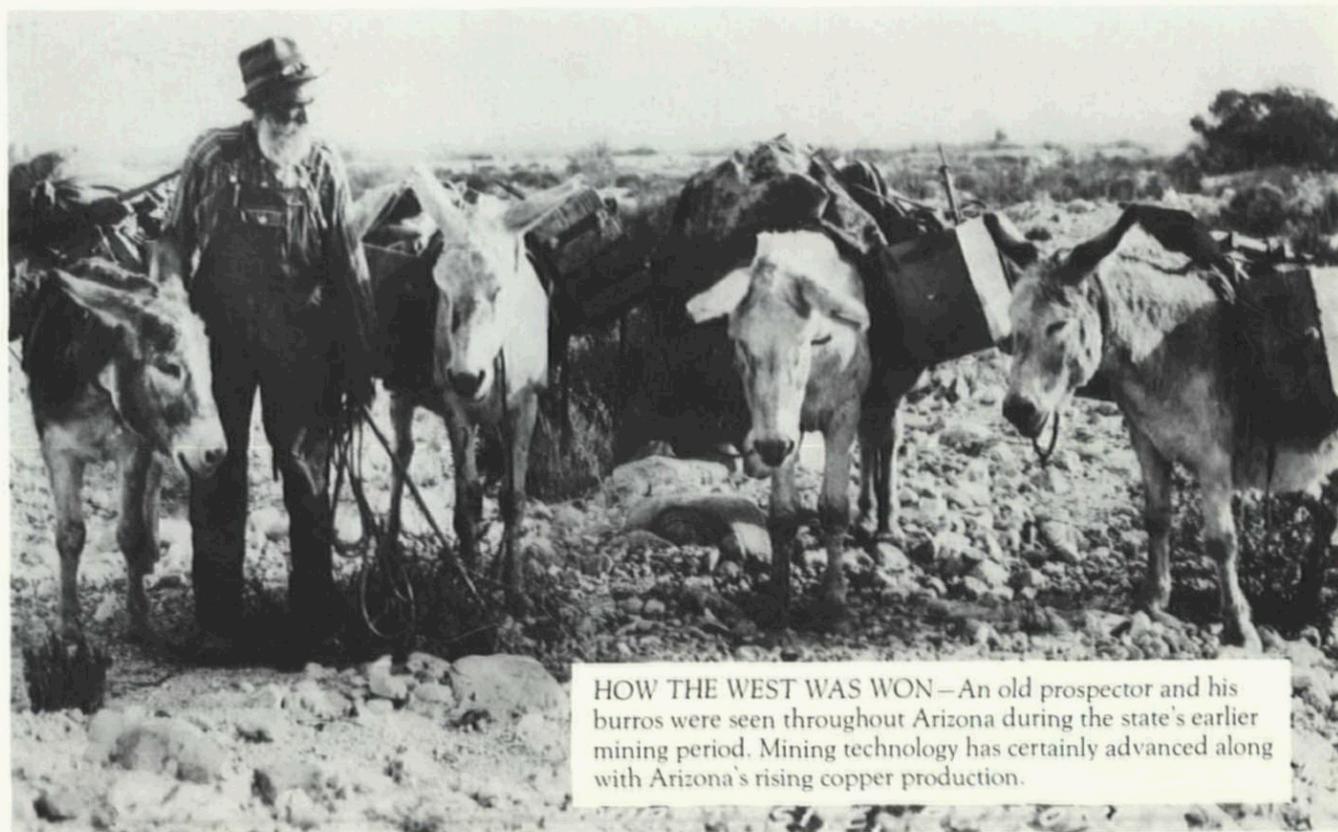
Miners had come here first looking for gold. And silver. Found it, mined it, moved on. Oh, there was some copper, too. And it was mined, if the grade was high enough. But it wasn't until 1879 that the lights really went on for copper.

That was the year Thomas A. Edison perfected the electric light. Three years later there were central power plants and lighting systems operating in

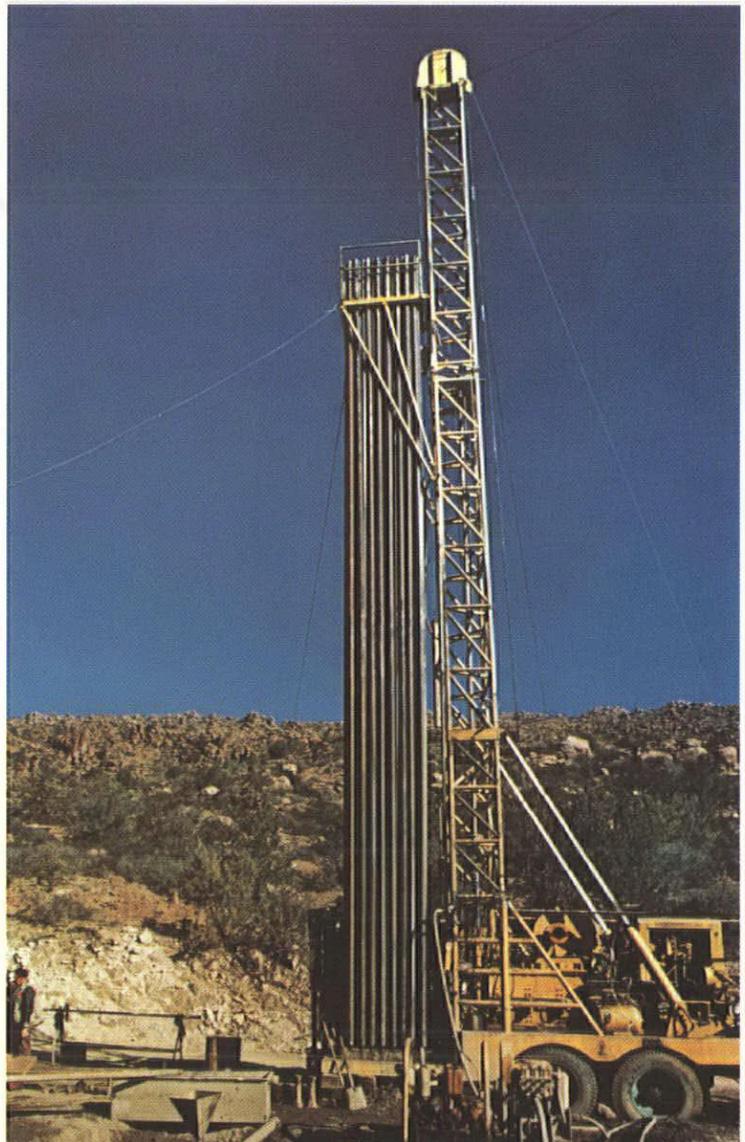
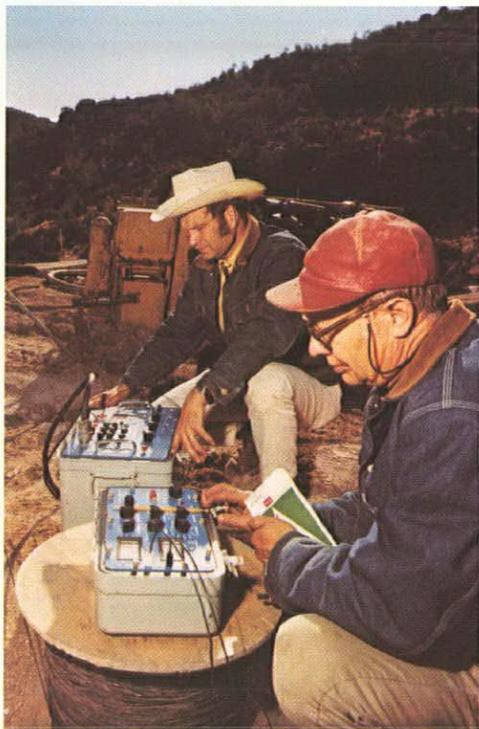
New York City and in London. Their electric generators required miles of copper wire. Transmission lines demanded more. Industry, in response to consumer demand, required still more to satisfy growing energy needs.

Copper was needed — urgently. And Arizona had copper. Mining activity skyrocketed.

Since 1910, Arizona has been the nation's top copper producer.



HOW THE WEST WAS WON — An old prospector and his burros were seen throughout Arizona during the state's earlier mining period. Mining technology has certainly advanced along with Arizona's rising copper production.



WINNING THE WEST TODAY—A few of the many methods which are employed in discovering ore deposits today are pictured above. At the top of the page is an airborne magnetometer. Above is field geophysical equipment, and at the right, a core drill.

## One out of eight jobs.

Copper's a mighty important metal for Arizonans. Its presence creates jobs. In fact, about one out of every eight jobs in the state depends on the copper mines. That's counting the men and women who do the mining, milling, smelting and refining, and the thousands of other Arizonans who supply the tools, services and equipment the industry needs as well as providing miners and their families with food, clothing, shelter, education and entertainment.

The mines are also good customers. Arizona copper producers purchase more than 70 per cent of all the goods and services they need from businesses in the state.

Tax revenues generated directly and indirectly by Arizona's copper industry amount to about one of every four tax dollars paid to state and local governments.

And the miners themselves are in turn good customers, thanks to the better than average wages and fringe benefits they receive.

All told, during an average year, the copper industry contributes to the Arizona economy 46 times the net value of resources removed from the earth.

And all this from an industry that uses only about one-quarter of one per cent of Arizona's land surface. To help you picture that, if you were the state of Arizona, the area occupied by mining would be less than that covered by your wristwatch.

Pay to the  
order of \_\_\_\_\_

**FIVE**



# Arizona's Mines

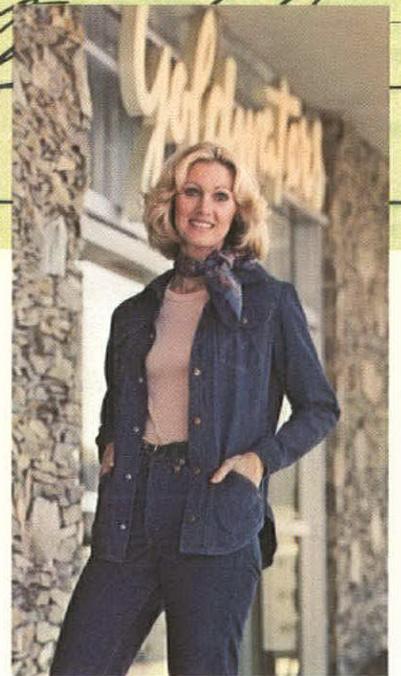
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## It's only a rock until...

We hate to disappoint you, but these beautiful specimens are not the typical, everyday copper ores. The run-of-the-mill material is as drab as dishwater. True, there's a minute quantity of copper locked inside, but a rock is only a rock until man does something about it.

### Identify ore specimens.

Rock becomes ore only when technical ingenuity and huge investments by thousands of individual stockholders find ways to extract and sell the metal. And do it at a profit. And that in itself is quite a project. That's because the ores from today's underground and open pit mines contain so little copper — averaging less than six-tenths of one per cent.

In a typical mine, we have to haul away two tons of rock and dirt to obtain one ton of ore. And that, reluctantly, gives up about 10 pounds of copper.

### The oxide ores.

If the ore has been exposed to "weathering," a process which takes thousands of years, it will oxidize and can change its color to many shades of brilliant blues and greens.

The common oxide ores in Arizona's mines are Azurite, Chrysocolla and Malachite. Turquoise, a copper oxide mineral, is also found in some of Arizona's mines. To extract the copper from such minerals, the ore is often crushed and saturated with dilute sulfuric acid which dissolves the copper from the mineral and forms a solution called copper sulfate.

Through a process known as electrowinning, the copper is electroplated in metallic form on a pure copper sheet weighing about 10 pounds. The end product after seven days of electroplating is a pure 99.9 per cent copper cathode plate weighing approximately 110 pounds.

In order not to waste even lower grade copper materials, the material is often put in dumps through which dilute sulfuric acid is percolated. This copper-bearing solution is collected and placed in tanks containing tons of recycled tin cans.

The solution interacts with the iron in the cans, leaving a sludge which when dried is called "cement copper," a material containing approximately 80 per cent copper.

Cement copper in powder form is then sent to smelters for further processing into metallic copper.

### The sulfide ores.

If the ore has not been exposed to appreciable weathering, it maintains its basic form as a sulfide mineral. Common sulfide minerals found in Arizona's mines are Bornite (a peacock purple-blue), Chalcocite (a metallic grey) and Chalcopyrite (gold-like). These ores are crushed to a powder, treated with water and chemicals, and agitated. The desirable mineral elements separate from the waste material. The extracted copper concentrate, in powder form, is sent to a smelter for further processing.

At the smelter, fiery furnaces produce 700 to 800-pound slabs or "anodes" which are approximately 99.5 per cent pure copper.

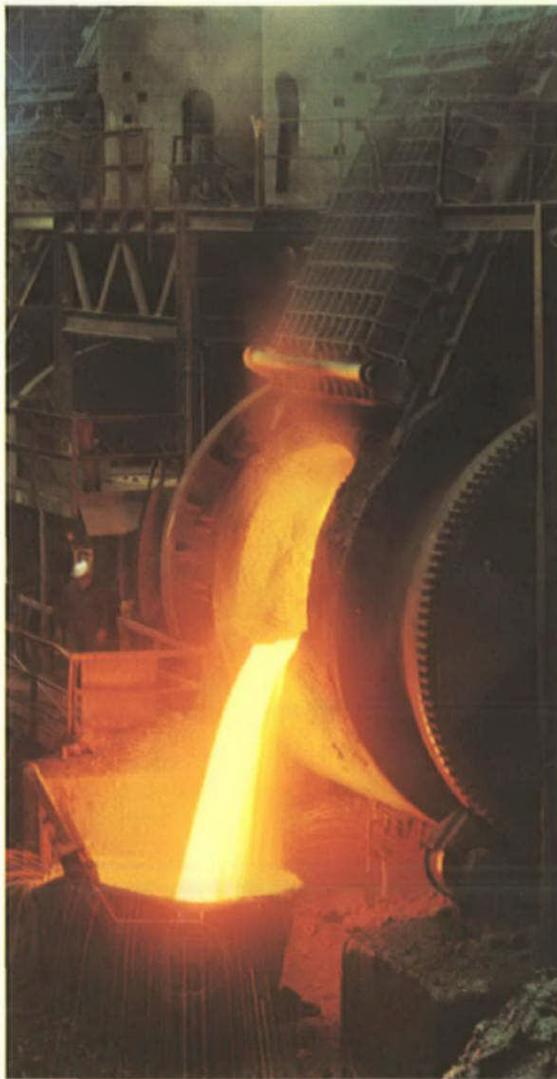
This still isn't pure enough for most uses. The anodes are then sent to an electrolytic refinery to be converted by electric current to metallic copper that's 99.9 per cent pure. Only when copper has been purified to

these standards, is it ready to be made into rods, wire, sheets, bars, tubes, plates, strips and other forms, and put to work for man.

Finding copper in the first place, and then finding ways to make it work for us, is a job calling for all the curiosity, innovation and persistence that men and modern science can muster. It's no job for amateurs!

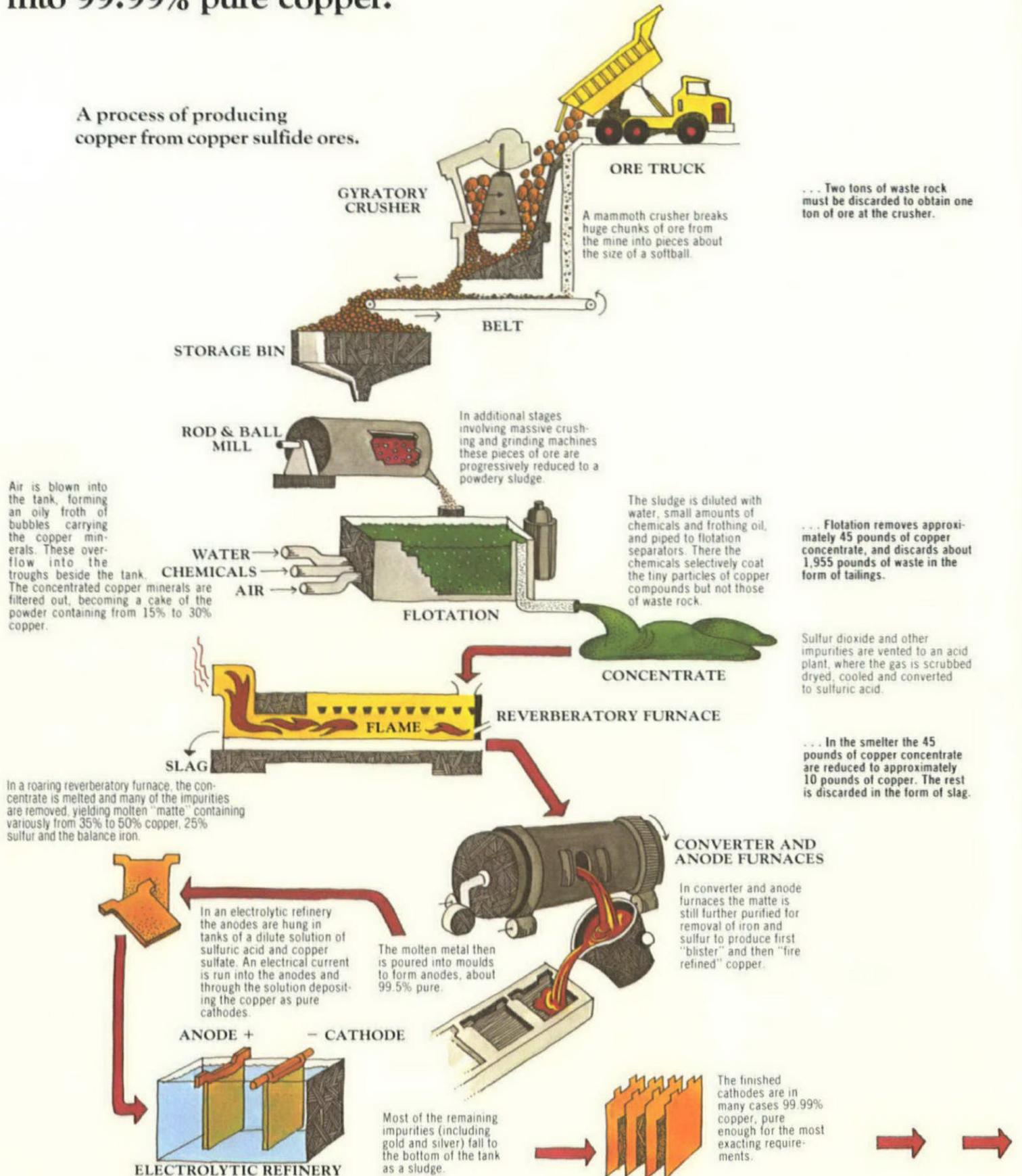
#### **Those valuable leftovers.**

Arizona ranks first in the nation in copper production. But we come up with some other important metals, too. We're number two in silver production. We're number two in the production of molybdenum, important as a steel-toughening alloy, and used in automobiles, airplanes and oil refining equipment. Arizona also ranks fourth in the nation in gold production. Most of the silver, molybdenum and gold produced in Arizona are by-products of copper operations.



# Processing 0.6% low grade ore into 99.99% pure copper.

A process of producing copper from copper sulfide ores.



... Two tons of waste rock must be discarded to obtain one ton of ore at the crusher.

... Flotation removes approximately 45 pounds of copper concentrate, and discards about 1,955 pounds of waste in the form of tailings.

Sulfur dioxide and other impurities are vented to an acid plant, where the gas is scrubbed, dried, cooled and converted to sulfuric acid.

... In the smelter the 45 pounds of copper concentrate are reduced to approximately 10 pounds of copper. The rest is discarded in the form of slag.

Note: Figures used are statewide industry averages and will vary at each operation.

**A process of producing copper from copper oxide ores.**

Copper is removed from oxide ore by leaching – using sulfuric acid solution to dissolve the copper from the ore – in place, in heaps or in large vats.

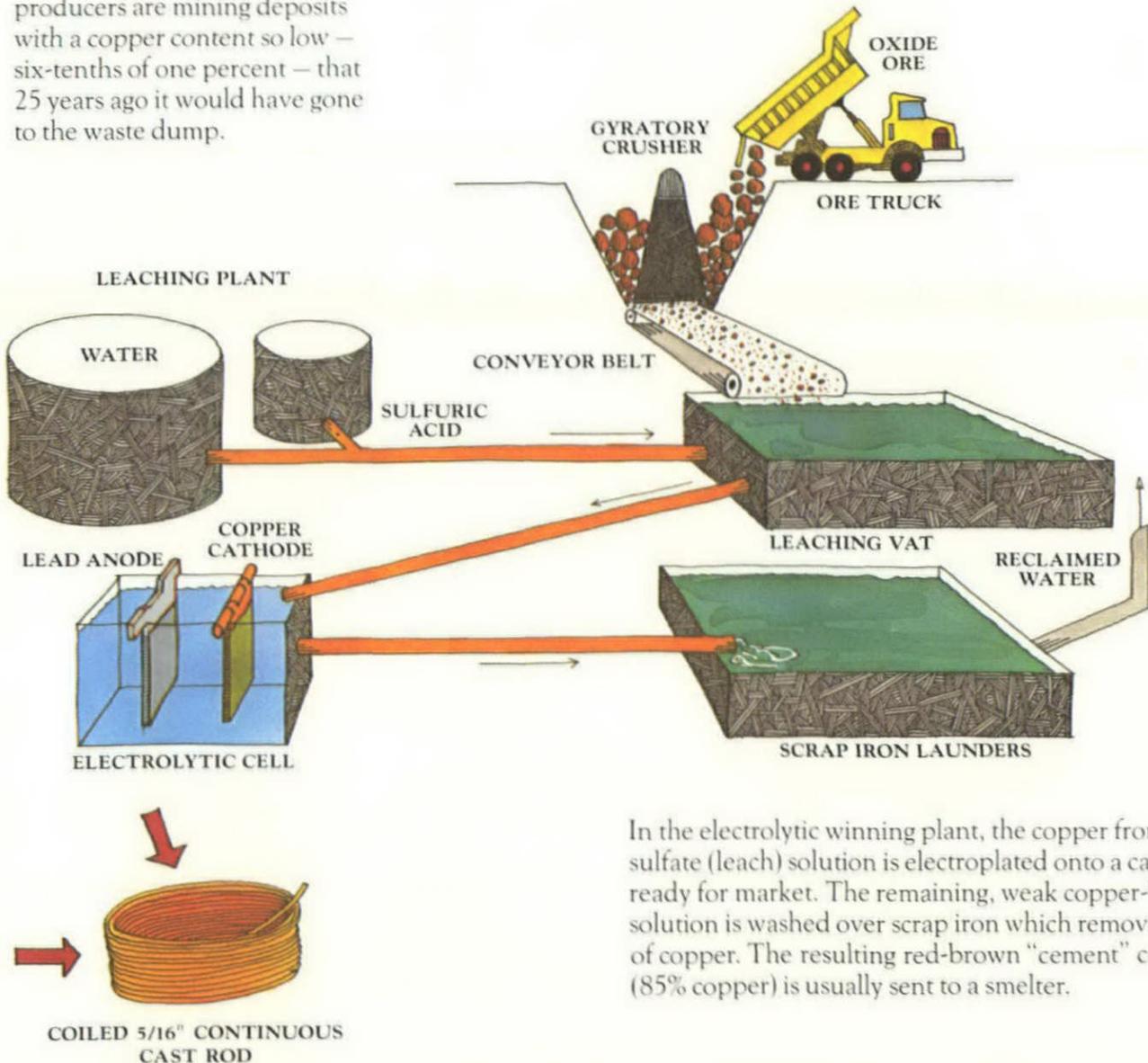
**Working low grade ores once considered waste.**

The “high grade” 5-10 percent copper ores of the early 1900s are nearly gone.

Today, Arizona copper producers are mining deposits with a copper content so low – six-tenths of one percent – that 25 years ago it would have gone to the waste dump.

The leaching process is being used at almost all Arizona copper mines to recover copper from low grade material, once considered too marginal to work. This is another conservation effort by the copper industry.

Year after year, Arizona’s copper industry continues to produce over half the nation’s new copper from low grade ores.



In the electrolytic winning plant, the copper from the copper sulfate (leach) solution is electroplated onto a cathode and is ready for market. The remaining, weak copper-bearing solution is washed over scrap iron which removes the last bit of copper. The resulting red-brown “cement” copper (85% copper) is usually sent to a smelter.



## From stone age to space age.

The Stone Age was doomed the day native copper was discovered. Once early man had learned how to use the easy-to-work "red metal," the days of the stone axe makers were numbered.

Their descendants one day would be picking up stones on the moon. The same red metal helped them get there. The Apollo command and service modules alone used almost 70 miles of copper wire. The massive communications and command systems on Earth employed far more.

Copper has long served man in so many ways because it possesses a unique combination of properties. It conducts heat better than any other metal except silver. It conducts

electricity better than any other common metal. It won't spark. It's non-magnetic. It resists corrosion. It's easy to work with and join to other materials, including plywood and vulcanized rubber. It alloys readily with other metals. The color is warm and appealing.

These very features predict a bright future for copper. From satellites to computers to office equipment to automation systems, power generators, electronic circuits, television, hospital X-ray and diagnostic equipment — anything using electricity — copper is the obvious choice.

Because it conducts heat so

well and resists corrosion so successfully, it's a natural for solar energy systems. And for desalting ocean water. A copper-nickel alloy has made the hulls of a fleet of fishing boats practically barnacle-proof. Copper metals are lending a warm, human touch to the decorative trim of our newest office buildings and high-rise hotels, while providing at the same time the finest electrical, plumbing and sprinkler systems available anywhere. Future uses of copper? They'll be limited only by our imaginations.

Yes, our grandchildren will still be depending on copper. But they will have a much more difficult time exploring for new ore bodies, as more and more land is withdrawn from mineral exploration. Producing the metal will continue to be a challenge, too. Even today, it's a costly process requiring expensive equipment and skilled personnel.

But whatever the problems, we Arizonans must still turn out a product that can meet competition from producers all over the world. It's an exciting challenge — and a tough one.



Decade 80 solar home photo courtesy of Copper Development Association.

## The world around us.

The difficulties of meeting environmental restrictions can be staggering, too.

Arizona copper producers have spent upwards of \$500 million on environmental controls.

Mine by-product (waste) piles are being planted with grasses and trees. And the mines are backing research in atmospheric studies and in agricultural applications of sulfuric acid, a smelting by-product.

Water conservation has always been a fact of life for the mining industry. Industrial water is re-used up to eight times. Conservation has resulted, among other things, in the creation of mountain reservoirs enjoyed year-round by thousands of Arizonans.

Recycling is old hat to the copper industry. Because the metal is practically indestructible,

it has been melted down and used over and over again for centuries. In fact, the copper mined at the time the pyramids were built may still be in use somewhere today.

To have copper, you've got to have *ore* — which again is a copper mineral that can be mined at a profit. And ore is where you find it. It occurs in streaks and patches. It is difficult to predict, with any success, where ore bodies may be found. And again, they're worthless to anyone unless they're (1) accessible, and (2) high enough in grade and size that the metal can be profitably produced.

Deposits like that are not found just anywhere.

That's why access to land areas for exploration is so critical to industry and to anyone who uses mineral products from the earth. If areas are closed to mineral entry, present and future Americans are denied metals and minerals that are vital to their welfare and security.

In the face of increasing worldwide competition, such denial could become a critical problem, making America and its citizens more dependent on

unreliable and costly foreign sources of all mineral products.

The Interior Department has already predicted that by 1985, unless we develop more of our copper resources, this country will need to import 34 per cent of its domestic copper requirements. By the year 2000, the report says, we could be importing 56 per cent.

With public understanding, copper production will continue in Arizona. It will continue to be a job maker for the state, an economic boon to everyone who lives here, and a key source of one of man's most valuable and versatile metals.

Think back to our little play on imagination from the first page of this story, and what life might have been like on "the day you did without copper." And be glad it was only fantasy.

Because if Arizona's copper industry has anything to say about it, that day will never come!



ARIZONA MINING ASSOCIATION