METALS & MAN in the PREHISTORIC MIDWEST

BY THOMAS J. RILEY

Metals are one of the cornerstones of western technology, and they possess many properties which other materials such as stone, wood, and bone do not have. Yet, for more than two million years of man's existence on earth, metals and their uses were unknown. Technologies depended on the inherent limitations imposed by stone, wood, bone, clay, and plant materials for tools to provide subsistence and basic creature comforts. It might be argued that human ingenuity peaked in the complex primary tools that were made from combinations of these materials. The lethal efficiency of prehistoric eskimo harpoons, for instance, is a function of the complex use of bone for point and toggle, sinew for hafting and line, and wood for both the foreshaft and the mainshaft. For modern man, the uses to which Solutrean flint projectile tips were put is overshadowed by their delicate beauty suggesting an aesthetic in stone materials some 18,000 years ago.

But, no matter how complex or beautiful, the tools made from these materials show a relationship between man and material where man had to fit his ideas of utility within narrow limits imposed by the stone or bone that he was working with. The sculptor who works with marble must bow to the properties of stone as well as to limitations of talent and vision.

Metals, on the other hand, have a vast array of properties that broaden the range of man's technological and aesthetic capacity. Copper, the first metal used by man in both the Old and New World can be beaten into pins and beads, heated and annealed to make it soft and ductile, melted for casting, smelted from ores, and combined with other metals in alloys with different characteristics.

The Bronze Age was one of the turning points of Old World technology. It began sometime before 7300 B.C. with the discovery of some of the more limited uses to which copper could be put. This was the first of a long and arduous series of discoveries that led to casting and alloying. The development of metal technology in the Old World saw the invention of new and more durable tools, more efficient weaponry, and a whole array of household conveniences that had been impossible with a technology based on stone, bone, plant fiber, and sinew.

The study of the development of metal technology in the Old World has provided a number of important insights into the processes of cultural change that have led to our own industrial technology. The crucial question that has never been satisfactorily answered, however, is how the properties of copper first came to be recognized by ancient peoples. The occurrence and use of pure native copper in the ancient world is limited, and the artifacts that we have left for us to study are few and far between.

Oddly enough, while deposits of pure copper are rare in the Old World, the metal is abundant here in North America. Few people realize that as the Bronze Age was unfolding in Asia, the Near East, and Europe, Native Americans were discovering on their own the properties of metals such as copper, silver, and even iron. For several thousand years eastern North American Indians tottered on the brink of the "metal ages." This American Indian experience with metals is giving archaeologists some new and valuable insights into the transition from stone-based to metal-based technologies.

The first use of metals in North America occurred in a context quite different from that of the Old World. The discovery of copper and its uses in the Near East was by people already engaged in village agriculture. In North America, on the other hand, copper was first used by hunters and gatherers in the upper Midwest around 4200 B.C. Agriculture would not become an important

Thomas J. Riley is assistant professor of anthropology at the University of Illinois.

part of these Indian cultures until the introduction of maize into the area some 4,000 years later.

The North American copper-working tradition was heavily dependent on large, rich deposits of extremely pure native copper around the southern shores of Lake Superior and on Isle Royale (in Lake Superior) near its southwest margin. A second important source of copper for Native Americans in the midwest was in the tills of the great glacial advances of the Pleistocene. Large copper nuggets were pushed forward by the advancing ice sheets from the area of the present-day Great Lakes to places as far south as central Illinois and Indiana. Even today Illinois farmers sometimes find in their fields large rounded fragments of pure copper that were deposited there more than 18,000 years ago.

Between 4000 and 2000 B.C. Indians of Wisconsin were making a startling variety of tools from copper. By 2000 B.C. axes, spearheads, knives, awls, and even fishhooks were being produced by ancient craftsmen in such numbers that well over 20,000 of them have been recovered by collectors and archaeologists. At this time, too, copper and the implements made from it were being traded south and east from Lake Superior, apparently over well established trade routes following major river courses.

pits into copper-bearing deposits. Although most have been destroyed by modern mining, the remains of some of these pits can still be seen at Isle Royale and on Michigan's Keweenaw Peninsula.

Estimates of the copper removed from the Great Lakes area from the beginnings of the prehistoric copper industry at 4000 B.C. to European contact are hard to come by, but at least one source has placed the possible yield at between 200,000 and 1,500,000 tons of metal! More recently Claire Patterson, a California Institute of Technology geologist, has estimated that about 5,000 tons of copper was mined during the thousands of years of Indian copper exploitation in the Midwest. Even Patterson's low estimates represent a massive labor input over time with some ten million pounds of copper finding its way south to the Gulf of Mexico and east to Pennsylvania and New York in trade and gift exchanges.

For quite a long time archaeologists assumed that most of the copper tools made by prehistoric Indians were simply cold hammered from native copper nuggets, and that the technology that they represented was basically uninteresting. Unfortunately, few archaeologists have any training in metallurgy and cold hammering was thought to be the simplest technology that

Copper bird effigy. Eye is of pearl. From Hopewell Site, Ross County, Ohio. Cat. no. 56356. Gift of W. K. Moorehead.

The trade in copper decreased during the thousand years before Christ and then increased again at about 150 B.C. with the development of what archaeologists have called the Hopewell Interaction Sphere. Copper appears to have been considered an important metal by people who participated in this massive trade network that encompassed the eastern United States from upper New York state to Florida. It is found in association with burials in conical mounds and was apparently used both for decoration and for the production of ceremonial objects.

The exchange of copper from the Lake Superior region was so heavy that Native Americans had turned from collecting surface copper outcrops and nuggets to sinking deep mining

could produce the array of tools that they recovered from prehistoric Indian sites in the Midwest. They did not realize that cold hammering is often accompanied by annealing — heating the copper to a temperature below its melting point to soften it so that the metal can be more easily reduced.

At first glance, copper seems to be an easy metal to shape by cold hammering. Indeed, a number of simple tools such as awls can be produced by simply hammering a lump of copper into an elongated form with a point at one end. But with extensive cold hammering alone, copper becomes brittle as it is reduced. After awhile the hammer-wielder finds his hammer bouncing off the deformed nugget with no appreciable results in

(Continued on p. 24)

Edward E. Ayer Film Lectures

March and April

Saturdays, 2:30 p.m.
James Simpson Theatre

The ground-level west door entrance provides free admission to James Simpson Theatre. However, access to other museum areas requires the regular fee or membership identification. These illustrated lectures are approximately 90 minutes long, and are recommended for adults. Doors open at 1:45 p.m.

March 3
Venezuela: Land of Natural Wonders
by George Lange

Beginning in the modern capital city of Caracas and ending at Angel Falls, the world's highest waterfall, this film includes exotic wildlife, rugged scenery, and scenes of Venezuela's diverse peoples.

March 10
Russia
by Dick Reddy

A tour of Russia, taking you to some of her great cities and historical landmarks: Moscow, Leningrad, and Kiev; the Kremlin, the Winter Palace, and the Hermitage. The Bolshoi Ballet and Black Sea resorts are also on the itinerary.

March 17
Sweden—A Midsummer's Dream
by Ric Dougherty

See Sweden from the south at Malmo to the north at Kiruna. You will visit the famous glassmaking region around Orrefors and accompany the Lapps on a reindeer roundup. Folk arts and customs are also the subjects of Dougherty's camera.

March 24
Germany—Once upon a Time
by Kathy Dusek

Germany is rich in myth and legend. Think of all the folktales that originated there: Snow White, Hansel and Gretel, The Pied Piper, and many more. Travel to the land and the people that still exist in story-book Germany.

March 31
Egypt—Gift of the Nile
by Doug Jones

One of the world's most ancient cultures is also in the forefront of modern events. From King Tut to Sadat, this film traces Egypt's remarkable history.

April 7
China after Mao
by Jens Bjerre

This is a rare opportunity to travel through modern China. Every scene abounds in unexpected surprises. You will see how the world's most populous nation is striving to become one of the most advanced.

April 14
The Marsh—A Quiet Mystery
by Tom Sterling

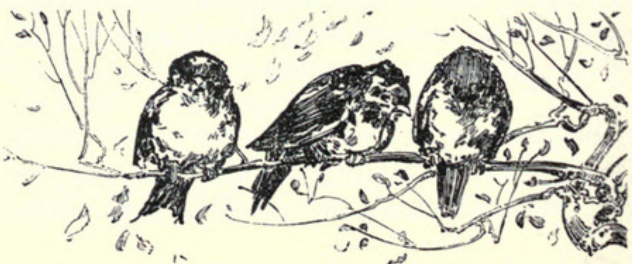
In an effort to increase public awareness of the value of wetlands, Tom Sterling has explored, studied, and filmed the marsh and its life. Filmed most extensively in the Michigan marshlands, this work also incorporates the marshlands of Utah, Oregon, and Ontario.

April 21
O Canada!
by Ken Richter

"O Canada!" is a filmed exploration of two facets of Canada's identity: that 200 years ago Canada decided not to cut its ties to the Old World; since then it has made an effort to preserve the cultural heritages of many peoples who now live there.

April 28
Discover Japan
by Ted Bumiller

Japan, with its civilization so profoundly different from our own, both surprises and excites the traveler. Among the places you will visit are: Mount Fuji, Tokyo, Kyoto, Hiroshima, and Nagasaki.



Feather Arts

BY PHYLLIS RABINEAU

Photography by Ron Testa

On February 15, Field Museum will open the doors of a new exhibition, *Feather Arts: Beauty, Wealth, and Spirit from Five Continents.** For four months, 260 beautiful objects from many cultures, all made from feathers, will be on public view in Hall 26; the exhibit will then travel to hosting museums throughout the United States for an additional 18 months. This is the first major travelling exhibit to be drawn almost entirely from Field Museum's own permanent collections. Most of the objects have never before been on display, but were selected from the extensive research collections housed in the Museum's storage area.

All colors of the rainbow, all sizes, shapes, textures, and moods will be found in the feather works drawn from cultures of all parts of the globe. In addition to explaining the techniques involved in creating the objects, the exhibit will explore several themes, each a universal aspect of feather arts: plumage as body ornamentation, feathers used for wealth and status, and the symbolism of feathers in religious beliefs. (See the December 1978 *Bulletin* for additional information on the exhibition content.)

As curator for this exhibit, it is an exciting time for me. A project I have worked on for over three years is about to be completed—something which has been a private research endeavor is at last to become quite public. Already, I have marvelled at the growing number of Museum specialists working on various aspects of this project: preparators putting together Plexiglas display mounts, the conservator cleaning and reconstructing long-unseen artifacts, the editor refining catalog copy, the ornithologists identifying specific feathers in each artifact, the photographer patiently adjusting the lighting for catalog photographs, the designer arranging a model of the exhibit hall. All of these people are using their special talents to create a marvelous experience for the Museum visitor. I have truly enjoyed the collaborative effort which is making my idea a reality. By working closely with this team, I have learned a great deal—from our discussions have resulted fresh ideas about the artifacts as well as new insights into the process of collaboration. In the long run, while I will be happy to see *Feather Arts* in its final form, my greatest reward will be the invaluable experience of having participated in this undertaking.

For most people working at the Museum—and undoubtedly for most of our visitors—feather arts are a revelation. They've never seen most of the objects, or at least never paid attention to them. Everyone knows what a Plains Indian eagle feather war bonnet looks like, but how many people know what kind of feather headdresses are worn in Brazil, the Philippines, or New Guinea? Even in the professional anthropological literature, feather arts are virtually ignored,

Overleaf. *P. 8: Topknot plumes of the crowned pigeon decorate a man's ornamental comb from Papua New Guinea (detail). Total length 41 cm. Cat. no. 276369. P. 9: Two different styles of men's headdresses from Brazil.* Above, *a simple string of brown, yellow, and red, made by the Kayapo; length 112 cm.* Below, *an intricately crafted and brilliantly colored feather "visor" made by the Urubu; diameter 32 cm. Cat. nos. 288190 (above), 168283 (below).*

**Members' preview Wednesday, February 14*

Phyllis Rabineau is custodian of the anthropology collections.

A pair of head ornaments from the Philippines shows cut and trimmed feathers. These buoyant plumes responded to every movement of the wearer's head. Height 49 cm (each). Cat. no. 109407/1,2.

though they are made almost everywhere. Volumes are written about ceramics, woodcarving, textiles, and metallurgy, but these more delicate artifacts made from plumage are seldom mentioned.

I began thinking about feather headdresses in my graduate studies at Brown University, whose small anthropology museum has a remarkably well-documented collection from the Cashinahua, a native people of eastern Peru. There were almost 100 feather headdresses, and I studied the individual variations among them. I soon became fascinated with the symbolic meaning of these objects and began to research not only featherwork but the religious ceremonies in which it was employed. To my surprise, I found that anthropologists had given very little attention to this material, even though feather headdresses are the most striking form of visual art to be found in all of tropical South America.

When I came to Field Museum as custodian of anthropology collections in 1974, I had a fabulously rich resource at hand: one of the world's great anthropology collections. My job was to care for the storage collections, and to help visiting researchers use them—to be a "librarian" of artifacts rather than books. From the start, I spent a great deal of time in storage rooms, learning what riches could be found at Field Museum, so that I could help others locate collections they might need.

In this "library" I found myself constantly drawn to the artifacts made from feathers, objects recently added to my experience. Delicate feather inlay jewelry from China, eerie black feather costuming from Melanesia, buoyant dance ornaments from the Philippines—it was an incredible discovery! Once again, I set out to read what I

A rare headdress from the Torres Straits (Papua New Guinea) was worn during special dances whose strenuous movements demonstrated the virility and stamina of the male performers to an admiring female audience. Length 50 cm, width 36 cm. Cat. no. 276369. ►

could about these objects and their cultural context and, as before, I was surprised to find that there was precious little to go on. A few scholars had examined the techniques, the psychology, and the use of feather ornaments in scattered areas of the world, but it was largely unexplored terrain. One had to dig ever deeper for a few nuggets of fact or theory, and so it was only natural to try to relate information about feather arts from the Pacific, for instance, to additional data from South America. The similarities and the differences were always of interest to me.

The idea of putting all these beautiful objects together in an exhibit, comparing their uses and meanings, came about from the simple impulse of wanting to be able to walk into a room full of the things I had been looking at in widely-scattered corners of our storage areas. I began to talk about the idea at the Museum, and then I had a stroke of the most wonderful luck. A new collection of Brazilian featherwork was given to the Museum by Mr. and Mrs. Theodore W. Van Zelst of Glenview, Illinois; they also offered a grant to cover part of the expenses for an exhibition as well as for a catalog on feather arts!

And so the real work began: the final detective work with scholarly sources, looking for data on cultural contexts of the artifacts; the intensified search in storage collections. Finally, last spring, I began to work closely with the exhibit designer, Clifford Abrams. We made the final selection of artifacts to be displayed, defined the theme areas, and decided which artifacts would best typify those themes. I set to work writing labels and catalog text while he designed the installation. Gradually we picked up more and more co-workers to take care of the hundreds of details involved in a project of this kind.

There are still many problems to be solved, especially the thorny question of how to pack and ship these delicate and fragile objects. While certainly not as valuable as the golden treasures that have recently been displayed around the United States, these objects are important as beautiful art works, fragile survivors of craft traditions no longer practiced, and often embodying spiritual beliefs which we must respect. However, most of the work has been completed, and for me this particular project is almost ended. The designers and preparators will move on to the next exhibit—and I will return to the storerooms. For me, in a sense the work has only begun on feather arts. In the course of assembling this project, I have uncovered several provoking questions, some mysteries about the craft and context of featherworks. There is a lot more research waiting to be done, more feathers to be seen, and—it is hoped—some fieldwork to be done in a living craft tradition. I'm looking forward to the next step. □

Gifts of feather capes were traditionally used to seal political agreements among Hawaiian chiefs. This use was later extended to European dignitaries, and this cape was presented to England's George IV by the Hawaiian King Kamehameha in 1821. Diameter 80 cm. Cat. no. 272588.

A Glimpse Of The Porcupine Mountains

Text and photos by
John and Janet Kolar

About 1,500,000,000 years ago a convulsion of volcanic activity devastated the southern edge of the Canadian Shield—a vast plain of Precambrian rock covering the northeastern fifth of our continent. Immense volumes of lava spread across the surface until the crust sagged beneath its weight, creating the trough of what is now western Lake Superior.

Simultaneously, the edges of this basin lifted above the surrounding surface, forming, on the north, Isle Royale, and south of the lake, a ridge running from the Keweenaw Peninsula to near the present Wisconsin-Michigan border. Then, sections of the southern edge of this ridge broke off and lumped back toward their original elevation, forming lines of alternate cliff and valley, parallel to the lake shore. Today, these ridges, polished by glaciers and eroded by rivers draining northwestward into Lake Superior, are known as the Porcupine Mountains, the name originally given them by the Indians.

Before the coming of white settlers, most of Michigan's Upper Peninsula was covered by a mixed conifer-northern hardwood forest. Then, around the mid-1800s, the hardwood component of this forest began disappearing into charcoal kilns. The charcoal, in turn, was used to fuel smelters that produced pig iron, which went to manufacturing centers of southern Lakes Michigan and Erie. Because of the distance to lumber markets, the pines (softwoods) were not cut in great quantities until near the end of the century, when the Soo Canal was opened. The products of the saw mills could then be shipped economically down the Great Lakes. As a result, accessible stands of pine were readily depleted. But within the mountain region, the irregular terrain and the turbulent rivers succeeded in preserving many virgin stands of pine and hemlock, together with their original associations of ferns and lichens. Today, even areas that were logged are now tending toward stable native climax forest, passing through a natural succession of plant communities. Only in continuously disturbed areas along roads and in campgrounds do the introduced Eurasian weeds occur in abundance.

Some 85 miles of trails are arrayed in a network across the Porcupine Mountains. A few cross the scrub oak cliffs above Lake Superior and eroded escarpments overlooking the interior river valleys; others descend to these valleys, following streams and rivers that acknowledge each geological stratum with a waterfall or rapids. Some trails come to abrupt ends at peaks or at overlooks; others meander along lake shores and swamps that are reminders of the last glacier. Several routes follow old logging and mining roads which were not prohibited until 1945. At that time, the state of Michigan designated 91 square miles a state wilderness area in a modest gesture of deference to a land that was ancient when our species was new. □

The Kolars' camera lens found these mushrooms (family Agaricaceae) nestling in a shaded wood.

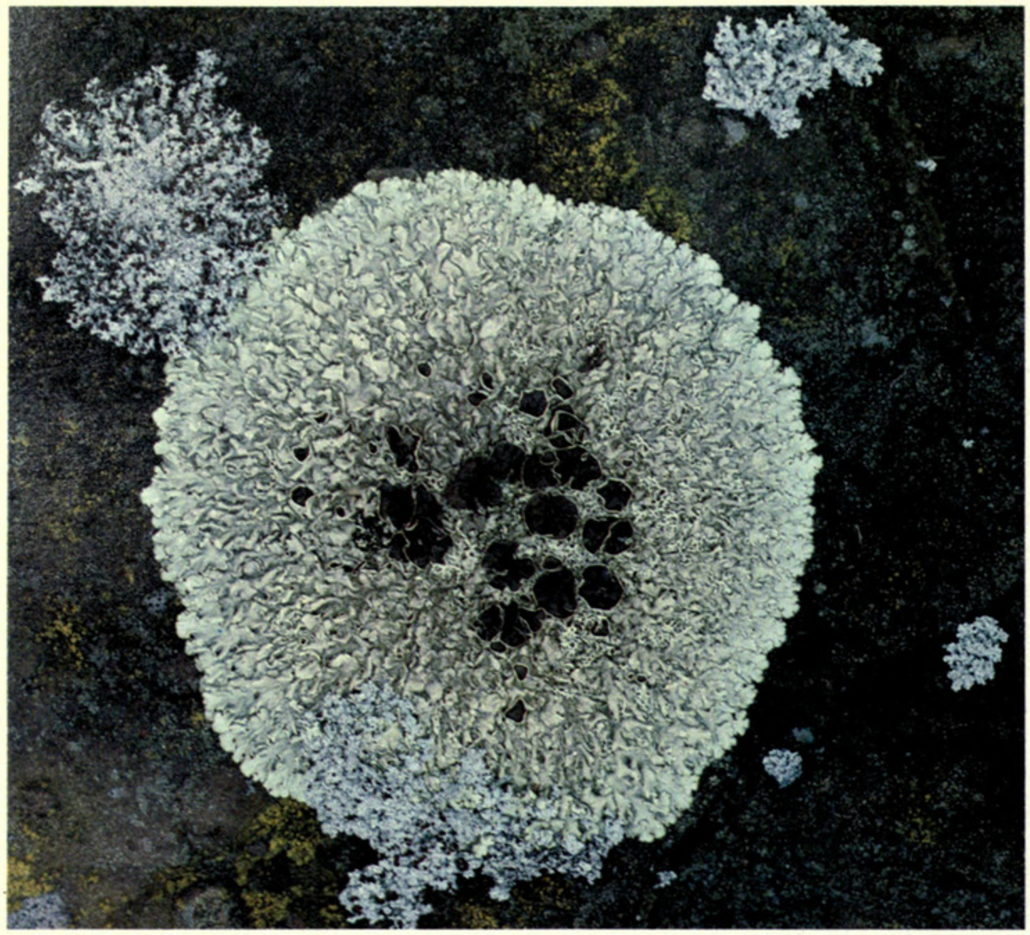
The photographic art of John and Janet Kolar frequently appears in the Bulletin. *John Kolar is a Field Museum volunteer.*

Overleaf. *Falls and rapids on Lower Presque Isle River.*

Lake of the Clouds, east end. At upper right may be seen marshes of Inlet Creek. Hills at left are overgrown with virgin stands of white pine and hemlock.

Falls on the Union River

Mushroom, family Agaricaceae



Patches of lichen grow on exposed rock face of Canadian Shield.

Quiet section of the Carp River, west of Lake of the Clouds

Edge of Presque Isle River is lush with American arbor vitae and brilliant sugar maple. Clearly visible is graze line, or browse line, of resident deer.

The Solar Eclipse Of February 26

BY EDWARD OLSEN

In Mark Twain's novel, *A Connecticut Yankee in King Arthur's Court,* the hero at one point, finding himself in a tight spot, invokes the heavens to blot out the sun. When this happens, the populace, including the knights and ladies of the court, cry out in amazement and declare him a magician of the greatest kind — much to the consternation of his arch-rival, Merlin, the magician.

In a similar situation one of the heroes of H. Ridger Haggard's nineteenth-century thriller, *King Solomon's Mines,* pulls off the same stunt and saves the expedition from the hostile designs of a large tribe of Africans.

What these tricksters did, of course, was to wave their arms in the air and chant a "magic word" or two at the very moment a total solar eclipse was to begin. You have to agree it's pure magic for someone not only to remember, down to the minute, when a solar eclipse is going to take place, but to remember even the path of totality across the face of the earth. Anyone with that kind of memory deserves all good things that come to him.

Eclipses are indeed awe-inspiring sights. On February 26, we in North America will have a chance to see what will be the last total eclipse to be visible from this continent in this century. Unfortunately, the Chicago area will not be in a position to see a *total* eclipse; a partial one will be visible, however.

A total solar eclipse occurs when the moon passes directly between an observer on earth and the sun. The moon travels around the earth, and the pair — the moon and earth — travel around the sun. The moon, however, doesn't move around the earth in the same place as the earth goes around the sun. If it did, then every month, or twelve times a year, an eclipse would take place at lower latitudes on earth. Because of the tilt of the plane of movement of the moon around the earth, only an average of 2.37 total eclipses occur each year (that is, 237 eclipses in 100 years).

Even when a total eclipse is taking place, it cannot be seen everywhere on earth. It's obvious that those parts of the earth on the side opposite the sun — the night side — cannot see it at all. For those places on the day side, it depends on whether you are in direct line with the moon and sun. Predicting where and when total eclipses will take place was one of the first real successes of the modern mathematical sciences, although there is some hint that primitive builders of stone rings — like the famous Stonehenge in Wiltshire, England — may have had some notion of how to predict this phenomenon several thousand years ago.

For the eclipse on February 26, the path of totality will run from the northwestern United States (including parts of Oregon, Washington, Idaho, Montana, and North Dakota) across Canada, passing close to Winnipeg, then northeastward across Hudson Bay, Labrador, and en-

The Bettman Archive Inc.

Viewing the solar eclipse of Oct. 19, 1865, in New York ding in Greenland. In Chicago we are situated at an angle so that we'll see the moon blot out only about half the sun's face.

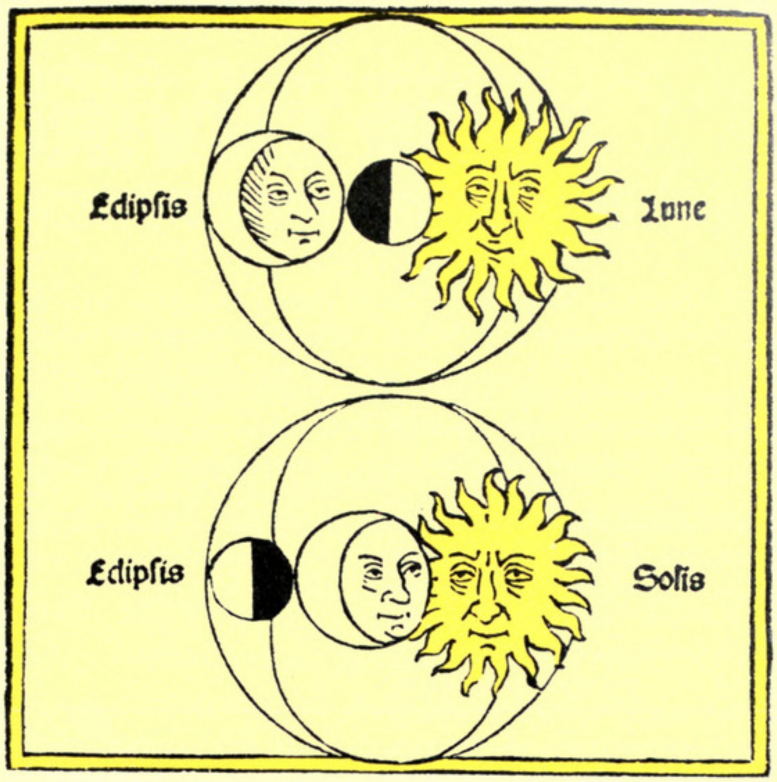
When viewing an eclipse, total or partial, there is a real danger of eye damage. Viewing the sun directly by eye can cause searing of the retina, which could lead to impairment of vision and, in extreme cases, blindness. Using ordinary sunglasses is *not* protection enough!

The safest way to view the eclipse is this: Take a big cardboard box, large enough to get your head and shoulders inside of it. With a large nail, punch a small hole through one side. Then stand inside the box, facing away from the direction of the sun, and move the box around so the image of the sun is projected through the hole onto the back wall of the inside of the box. When the moon's shape passes over part of the sun's face you'll see the image projected on the back wall of the box. Since you're only looking at a projected image of the sun you can't hurt your eyes. What you are doing is actually standing inside a simple lens-less camera — a so-called pinhole camera.

Because the sun is the central luminary body of our solar system it is of great scientific interest to us. Also, since it is a star, it is the only star we can study at close hand. Is it getting more active? Is it getting less active? How does its radiation affect radio communications here on earth, and the atmosphere of the earth? These are questions that can be studied during solar eclipses. Although it is possible to make scientific measurements of the sun on any clear day, certain kinds of measurements and observations can only be made during a total eclipse. This is why many astronomers set up temporary field stations along the path of totality prior to the eclipse. Most of their observations are made photographically.

By pure coincidence, the sizes and distances of the moon and sun viewed from the earth are such that they each subtend about a half degree of arc. This means that under the conditions of a total eclipse, the moon can almost exactly cover the sun. Were the moon much larger, or much closer to earth, then the sun would appear somewhat smaller than the moon and disappear completely behind it. As it is, under the best conditions, the thin outer fringe of the sun's atmosphere is just visible with the bright center blotted out. This permits photographic measurements to be made on the solar atmosphere without being ruined by the glaring light from the face of the sun.*

**Because the paths of the earth around the sun, and the moon around the earth, are not perfect circles, the earth-moon and earth-sun distances change slightly at different times of the year. This means that for some total eclipses the outer fringe and a thin edge of the sun's disc show around the outside of the moon. This is called an annular total eclipse.*



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1462 diagram of how an eclipse occurs

When the bright center of the sun is blotted out we can see long, streaming flares of hot gases shoot out thousands of miles into space from the sun's surface. From study of these flares we can determine some of the features of the magnetic and electrical fields that are generated around the sun. By means of the spectrograph we can also determine what chemical elements occur in various levels in the sun's atmosphere.

One of the most dramatic uses of solar observations during a total eclipse first took place in 1919. Einstein's theory of relativity had already predicted that a ray of light can be bent from a straight path when it passes close to a very massive body. By measuring the apparent position of a star whose light rays pass close to the sun on their way to earth, it was indeed found that the star's light was slightly bent by the right amount. Since 1919 this bending of light rays has been measured many times during solar eclipses and verified with greater accuracy each time.

Some measurements, however, made many times during total solar eclipses, have created a scientific puzzle that has still not been completely solved: The sun's surface has a temperature of about 6,000°C (about 11,000°F). Surrounding the surface is a region of gas called the chromosphere, which is hotter than the surface — around 25,000°C (about 45,000°F). Above this is the sun's upper atmosphere, the *corona*. Its temperature is a scorching 1 million degrees C (1.8 million degrees F). How is it that the temperature way above the sun's surface is about 140 times hotter than the surface?

This question, and others, will be studied during the coming eclipse. What a disappointment it will be if February 26 is a cloudy day! □

Edward Olsen is curator of mineralogy.

OUR ENVIRONMENT

Crustacean's Last Toehold: Rusty Drainpipe

A 90-foot piece of iron drain pipe leading to an abandoned bath house in New Mexico is the only home for 2,500 remaining Socorro isopods.

The U.S. Fish and Wildlife Service has proposed that this relative of the common sowbug be listed as an endangered species because of the link it may provide in the ecological and evolutionary web.

This half-inch freshwater crustacean, which eats the algae lining the drain pipe, is one of only two freshwater species in a family that is otherwise entirely ocean-dwelling.

Biologists think it may provide the key to understanding how this and other land-locked relic animals evolved from ancient marine isopods that lived in the oceans once covering much of the western U.S.

The Socorro isopod adapted to the warm, fresh water of a spring, where it lived for millions of years until the spring was capped in 1949. After that, the only place left to this small creature was the section of drain pipe.

This, the isopod's last toe hold, now is threatened by periodic drought and flushing of the pipes.

Dogs for Combating Coyotes

Komondors, which are shaggy, heavy dogs first bred in Hungary to keep wolves from preying on sheep, are the subjects of a $33,000 U.S. Department of Agriculture experiment to see if they can do the same for western sheep ranchers who claim coyotes are killing their sheep. Weighing as much as 120 pounds and costing up to $500, the dogs may be the sought-after alternative to shooting, trapping, and poisoning the clever coyotes. Komondors have already been found to frighten caged coyotes simply by walking past them. The tests, to examine ease of handling the dogs and their effectiveness in repelling coyotes, will be conducted at Colorado State University in Fort Collins and the U.S. Sheep Experiment Station in Dubois, ID.

Tipsy Birds

Around Perryville, R.I., the small, red berries of the Russian olive bush, overripe and slightly fermented, have been intoxicating flocks of birds that snack on them. Local farmers and motorists watch in amazement as birds haphazardly swoop down and over the highway, many missing their mark and slamming into trucks and cars. Such dive-bombing antics have strewn dead birds along the roadside, yet police are loath to charge the birds with f.w.i.—"flying while intoxicated."

Feds Act to Reduce Bird-Aircraft Collisions

The Federal Aviation Administration and the Interior Department's U.S. Fish and Wildlife Service have stepped up measures to prevent collisions between planes and birds and to further advance airline passenger safety.

Bird strikes, numbering about 1,200 annually, cost an estimated $20 million each year in damage to military and civilian aircraft. A 4-pound bird striking a plane moving at 500 miles per hour impacts with a force of 80,000 pounds and has been known to shatter a windscreen and badly dent the opposite cabin bulkhead. More often, however, birds are sucked into the jet engines, which can be instantly knocked out.

Bird strikes, or collisions, have also been blamed for the loss of 140 human lives in this country since such record-keeping was started in the 1940s. The most serious accident occurred in 1960 in Boston, where 62 persons died after their airliner flew into a flock of starlings.

Most bird strikes occur during take-off and landings, but the birds are also a threat in the air during the spring and fall migration season when millions of ducks, geese, swans, and other birds migrate in dense formations at altitudes as high as 20,000 feet. Bird populations at airports also swell significantly at these times.

Situated in many cases near water, mud flats, or marshy areas and quite often close to solid waste disposal sites, airports also attract birds because of architectural features that invite roosting, and decorative pools that birds use for bathing and drinking. Other attractions include standing water on runways or adjacent areas, tall grasses, fruit trees, and other vegetation, and the related insect and rodent food supply.

Simple techniques include draining pools, filling the low spots on runways, removing certain trees and shrubbery, and cutting grasses to certain heights. Other techniques include relocation of existing garbage dumps that may be in air traffic corridors, and operating regular motor patrols of the runways to disperse birds. Dispersal methods such as distress calls and explosive noise devices are also used to reduce the risk of bird strikes. All of these deterrents are aimed at denying food, water, and roosting areas to the birds in an effort to make them seek other, safer habitats.

Mastodons as Fox Bait

A Siberian native has probably found the ultimate in well-aged trapping bait. The trapper had exceptionally good luck catching foxes on his trapline using meat he had found frozen out on the tundra. Paleontologists then discovered that the bait was from the leg of a 13,000-year-old mastodon.

The paleontologists also found traces of an ancient settlement near the mastodon site. They estimated the age of the campsite to be about 13,000 years.

Ultrasonic Pest Repellent

Bob Brown, a California guitar player crippled by polio, has invented a device capable of making sound so shrill that it drives rodents wild, kills cockroaches, and sends fleas flying. The frequency of the sound is over a million cycles a second; the human ear can hear up to about 20,000 cycles.

In a recent 12-month period, Brown sold 18,000 of his so-called "rat-repellent boxes." The government of Venezuela ordered 300 to kill cockroaches in food stores; 1,000 were bought by Spain to eliminate rodents from granaries.

Treasures of Russia and the Ukraine

20-day tour for Field Museum Members and their families

THE SPLENDORS OF OLD RUSSIA, the excitement of the New are in store for Field Museum Members and their families who join the tour "Treasures of Russia and the Ukraine," leaving Chicago's O'Hare Airport June 19 and returning July 8.

Highlights of this exclusive tour will include visits to the cities of Moscow, Vladimir, Kiev, Leningrad, Petrovorets, Novgorod, and Petrozavodsk. The group, limited to 35 persons, will be led from Chicago by two Russian-speaking escorts, with additional guides while in the Soviet Union provided by Intourist *(the Soviet Travel Bureau).*

The tour cost—$2,970 (which includes a $500.00 donation to Field Museum)—is based upon double occupancy and includes round trip air fare from Chicago to Moscow, with intra-Russian air transportation where required. The transatlantic airline is Swissair.

Deluxe hotel accommodations will be used throughout or, where necessary, the best hotels available. The package includes all meals, including inflight meals; all sightseeing via deluxe motor coach; all admissions to special events and sites, where required; all baggage handling throughout, plus all necessary transfers; all applicable taxes and tips; all applicable visa fees. Advance deposit required: $250.00 per person.

For full itinerary, additional details, and registration information, please write or call Michael J. Flynn, Field Museum Tours, Roosevelt Road at Lake Shore Drive, Chicago, Ill. 60605. Phone: (312) 922-9410, X-251.

Red Square, showing Lenin's Tomb, Moscow

Copper ornaments and pendants from Hopewell Site, Ross County, Ohio. On view in Hall 4. The headdress is of two parts: a thick, solid headplate and wooden antlers covered with thin sheet copper. (Cat. no. 56080). The ear ornaments (56201-2) and pendants (56114, 56128) are of copper. (The necklace is of freshwater pearls.) Gifts of W. K. Moorehead.

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forming his tool. The metal, made brittle by cold hammering, often cracks and fractures.

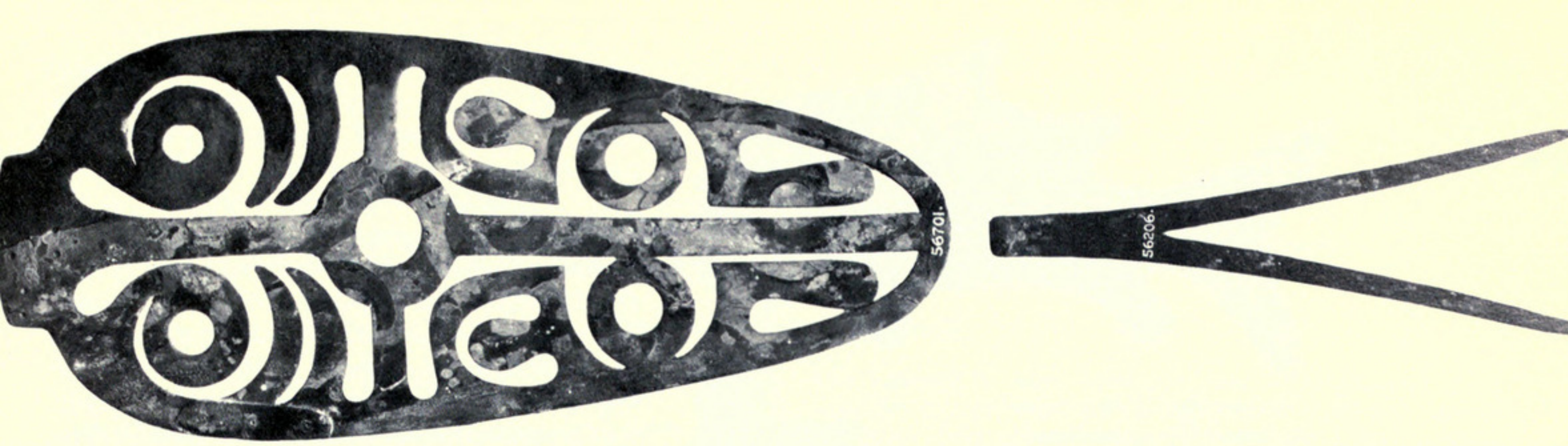
It took trained metallurgists interested in ancient technologies to begin to unravel the mysteries of native copper technologies in native North America. They did this by applying the techniques of metallography to the study of Indian copper working. Their research has shown that either hot working or successive anneals were important to the manufacture of native copper artifacts in the prehistoric Midwest. Unfortunately, a number of archaeologists have not understood the importance of their work, and at least two recently published textbooks in American prehistory still cling to the notion that Native American copper from the Midwest was produced by simple cold hammering.

Metallography, simply put, is the study of the internal structure of metals by various techniques including the use of powerful optical and electron microscopes. Metallographers most commonly study the structures of metals to discover the physical properties that determine the utility of metals for commercial and industrial purposes. A few metallographers, however, have turned their attention to the study of ancient metal artifacts to determine techniques of manufacture as well as the possible uses to which these tools were put. Native copper, like all metals, is crystalline in structure. When it is subjected to different treatments in manufacturing, the structure of the metal realigns itself in certain predictable ways. Extensive cold working, for instance, will deform the regular crystal alignments that metallographers call grains by compressing them or breaking them up. Reducing copper by cold hammering produces lines of flow perpendicular to the force of the hammer blows. Metallographers can see these patterns of deformation through an optical reflecting microscope when the metal is polished and etched with different corrosive solutions.

Annealing is accomplished by heating copper to a temperature above 200° to 225°C but well below its melting point of 1,083°C. This allows the metal to recrystallize, often with the formation of distinctive paired linear structures called "twins" within the grains.

Melting and alloying produce other, more complex structures within the metal. These microscopic structures permit the metallographer to reconstruct the techniques of manufacture of metal artifacts. In some instances they can determine the temperature at which the artifacts were worked and whether or not they were heated and worked in an oxidizing or reducing atmosphere.

In the spring of 1978, with the aid of Professor Heather Lechtman of the M.I.T. Center for the Study of Materials in Archaeology and Ethnology, I prepared a number of metallographic samples from copper artifacts found at several Hopewell Indian sites in Illinois. The samples were



Stylized serpent made of copper, restored. From Hopewell Site, Ross County, Ohio. Cat. nos. 56701 (left), 56206. Gift of W. K. Moorehead.

carefully cut from the artifacts with a jeweller's saw, mounted in a resinous medium, then ground and carefully polished so that surface abrasions were smaller than the wavelength of light. After this they were treated with solutions that would differentially etch the grain boundaries of the copper and accentuate the different planes of crystal alignments.

One of the samples from a Hopewell burial mound group near Utica, Illinois, is shown below: a small piece of native copper that has been partially rolled by cold hammering after an apparent anneal in a reducing atmosphere, probably under the ashes of a wood fire. When the sample was subjected to analysis under the microscope, the different techniques of manufacture become clear. At a magnification of ×50, the rolled end shows signs of the deformation of the metal perpendicular to the lines of force expected of cold hammering. On the thick end of the sample the grains are only partially deformed, and a number of partially bent "twins" suggest that the artifact was annealed before the final hammering process was begun. This part of the metal had not been reduced as much as the rolled end, and it is likely that the hammering had occurred after the metal had been allowed to cool. It also appears that the metal was hammered on the end that was rolled before the turning process began.

The tools of the metallographer, in this particular instance, permit the archaeologist to reconstruct the craft techniques of a Hopewellian craftsman who lived some 2,000 years ago in central Illinois.

An interesting feature of prehistoric midwestern copper working for the archaeologist is that it seems to occur in association with an innovation in stone tool technologies in the Midwest. Flints and cherts were one of the major materials from which prehistoric primary tools were made in North America. In Prehistoric North America some 10,000 to 3,000 years ago, Indian stone tool craftsmen began to treat flint with fire, "annealing" it before flaking stone tools from it. It is quite possible that the extensive copper working that is found in the Midwest from Archaic through late prehistoric times was simply an extension of the heat treatment of flint. Copper then, would have been considered just another stone which, when heated, showed properties different from those of flint in that it became soft and malleable rather than brittle and subject to fracture. It is possible that in the central part of what is now eastern United States the development of an extensive copper-working tradition depended on the innovation of annealing flint and other stone materials, and that a copper industry of any magnitude and duration would have been impossible without this innovation.

We know that one of the early stages of copper manufacturing in the Old World, too, depended on annealing the metal to make it workable. Is it possible that the copper industry there began with the extension of heat treatment techniques from flint and chert to the new material, native copper? At present little work has been done on the occurrence of heat treatment of flint in the Old World, but I would expect that this particular innovation in stone-working precedes the extensive use of copper for tools and artifacts wherever native copper appears in western and eastern Asia.

But copper was not the only metal used by prehistoric Americans. Small amounts of silver have been found in Hopewell sites in many of the Great Lakes states as well as in sites in Ontario. The silver has been beaten into thin sheets and used to cover reed whistles shaped like classical panpipes. Silver was also beaten onto a copper base to form large round earplugs shaped very much like large spools. Beads and head ornaments of silver have been found at a number of sites in western Wisconsin and Illinois.

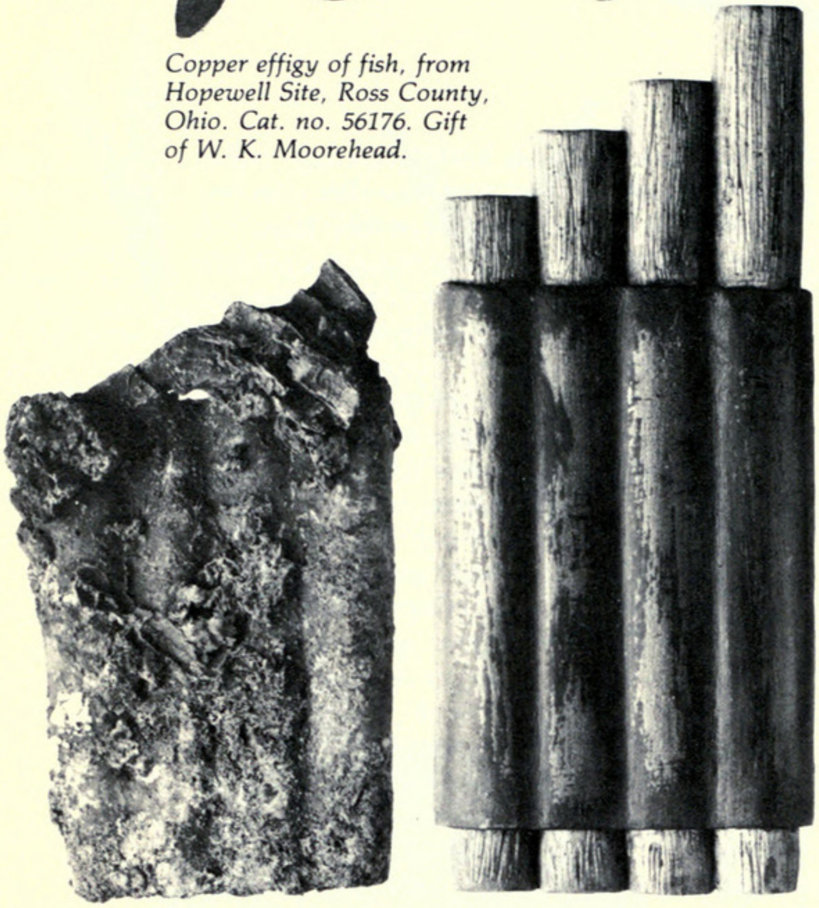
Meteoric iron, too, has been found at sites both in Ohio and Illinois. A set of meteoric iron beads was recovered from a Hopewell mound near Havana, Illinois, by researchers from the Illinois State Museum in 1945. When subjected to metallographic analysis, it was discovered that the small beads had been cold hammered around a small cylindrical object to create center holes of the beads, then subjected to a light annealing procedure. The manner of production parallels the manufacturer of copper objects.

Prehistoric American craftsmen in the Midwest obviously recognized the importance of a number of native metals. Why didn't they develop that tradition into a regime of smelting, casting, and alloying that would have led to the beginnings of a bronze age in eastern North America? We shall probably never know the answer completely. It is probable that the abundance of native copper around the Lake Superior region made it unnecessary to develop procedures for smelting metal from copper oxide deposits, and thus the first major advance towards true metallurgy was not necessary in this part of the New World.

In the Near East, on the other hand, the scarcity of native metals made it necessary to melt deposits of copper oxide ores to maintain the nascent copper industry. From that start the development of more difficult techniques for smelting copper from sulfide ores followed rather quickly.

It is likely, then, that the eastern North American metal industry in prehistoric times suffered from an abundance rather than from a scarcity of relatively pure metals. Nevertheless, the achievements of prehistoric American craftsmen in extending the techniques of stone technology to copper, silver, and other native metals cannot be overlooked. It is an area where the metallurgists of our day using the sophisticated techniques of their trade can answer questions that the archaeologist left to his own devices cannot even begin to fathom.

Copper effigy of fish, from Hopewell Site, Ross County, Ohio. Cat. no. 56176. Gift of W. K. Moorehead.



Above: *Pan pipe of bone, with copper sheathing, original (left) and restoration. Cat. no. 56708. Gift of W. K. Moorehead.*

Early engraving (1565) of Florida Indian chieftains adorned with copper pendants.