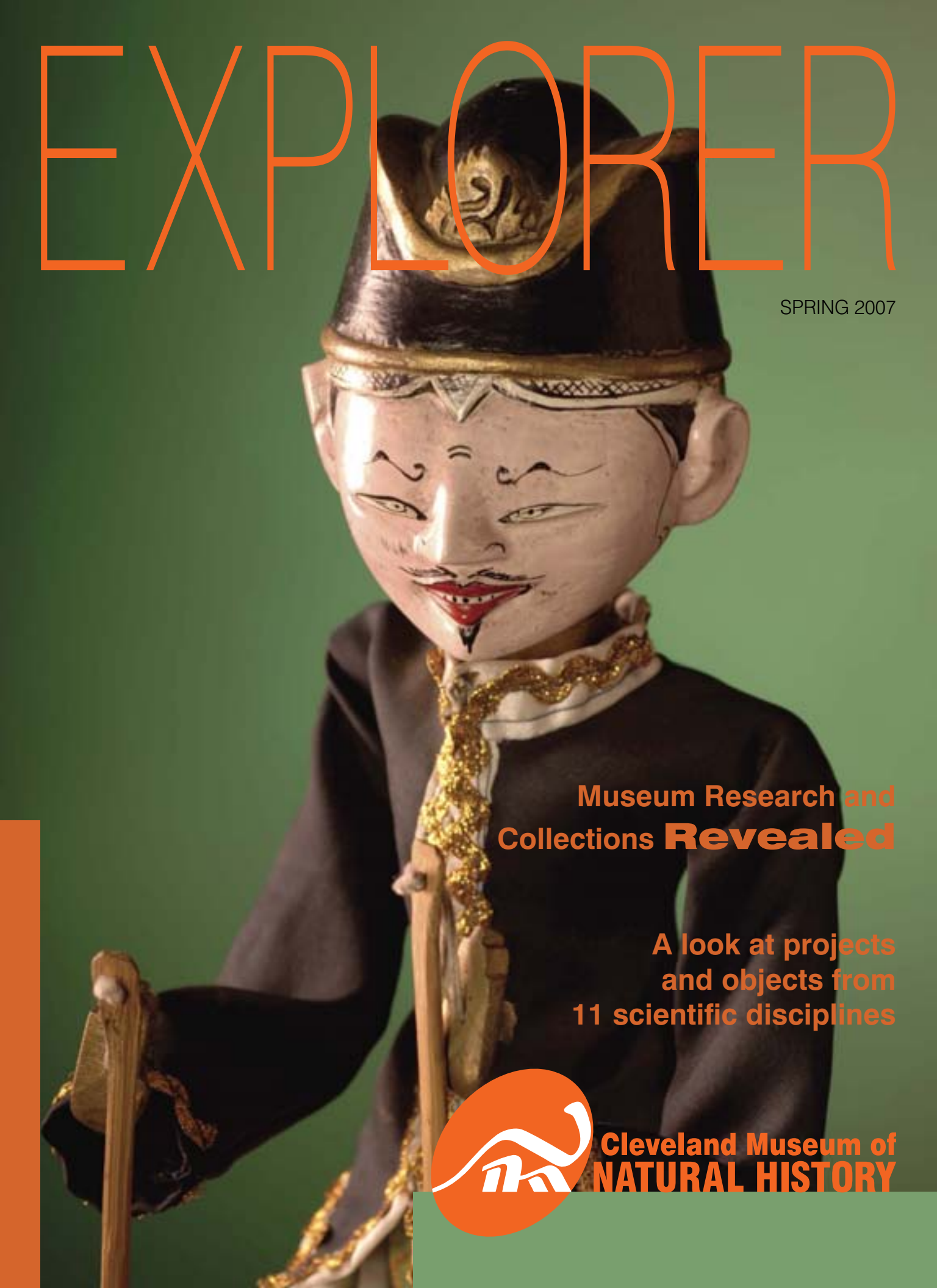
EXPLORER

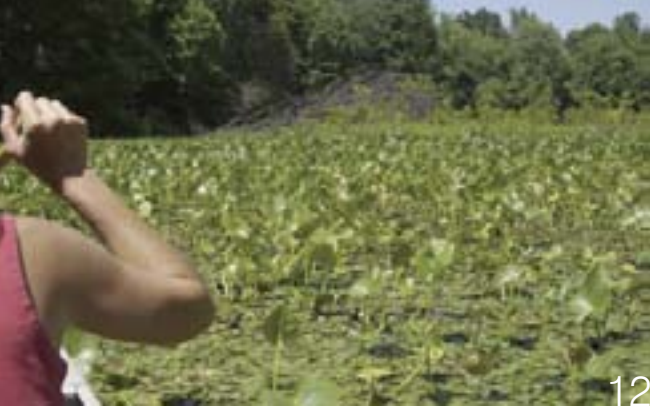
SPRING 2007



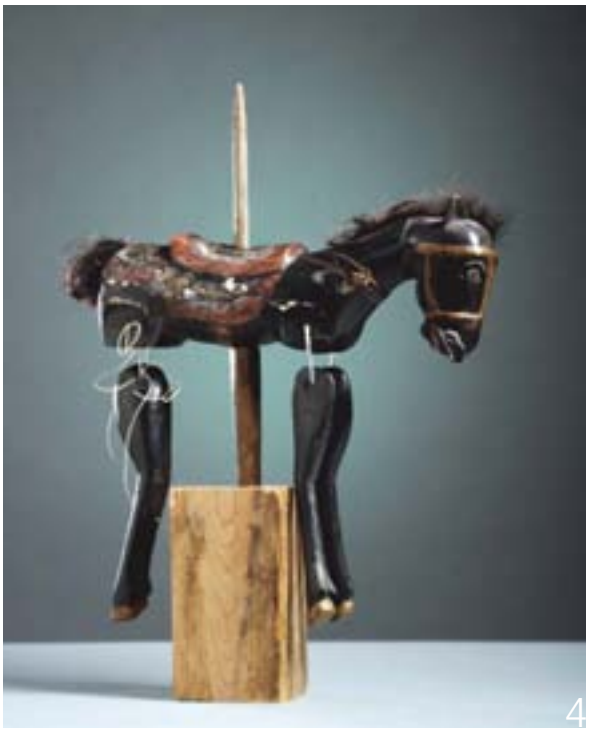
Museum Research and Collections Revealed

A look at projects and objects from 11 scientific disciplines

Cleveland Museum of NATURAL HISTORY



Elizabeth Russell



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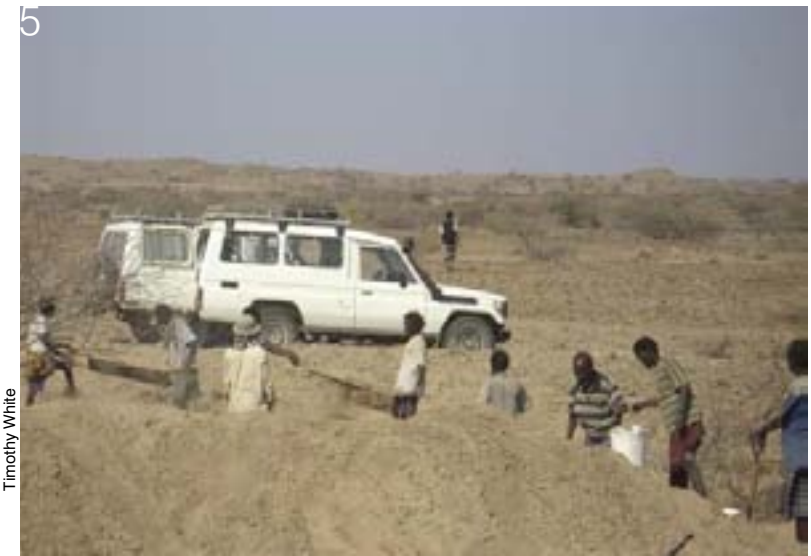


Timothy White

From the Executive Director

The value of collections

I got into collections young.

All through my youth, I collected fossils, shells, feathers and animal skulls. In fact, I lost a high school sweetheart because she thought my skull collection was a bit unusual.

My mother also had problems with me using the kitchen stove to prepare the skulls I'd collected, and she banished me outside to boil them on a camp stove. Little did she or anyone else realize what a major role bones — and collections of bones — would eventually play in my life as I pursued a career in physical anthropology.

I think that many scientists, particularly those involved in the natural sciences, begin collecting items from nature as children. I know that many of my Museum colleagues did. Even my close friend and fellow-fossil hunter at University of California, Berkeley, Dr. Tim White, collected snakes and other creatures as a kid growing up in Southern California.

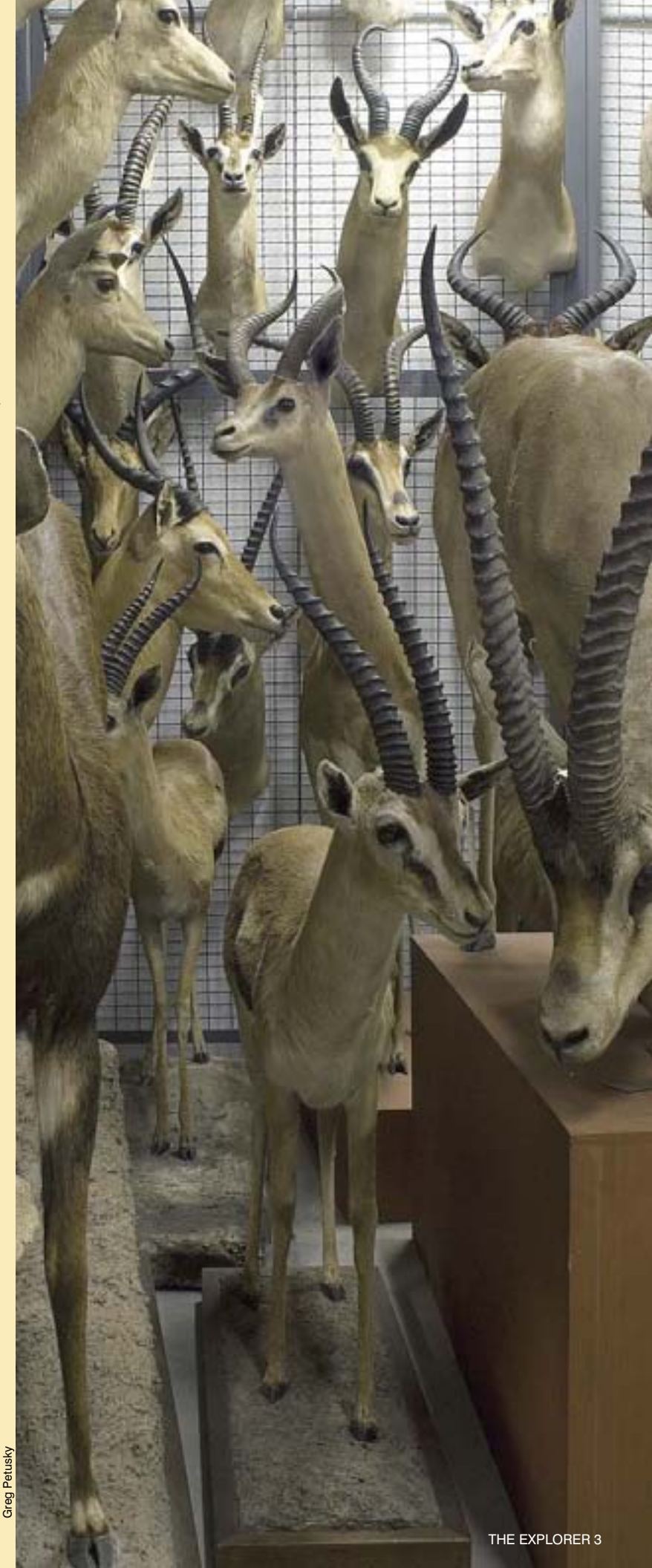
Collecting provides early training in the skills that a career in science later requires: the desire to learn more about something, the ability to observe and a willingness to ask questions until your curiosity is satisfied.

The beauty of working as a scientist in a natural history museum is that you never have to stop collecting — in fact, it's part of your job. Here at the Museum, we study, maintain and, yes, add to an amazing collection of objects from the natural world (and the human one, too, I should add).

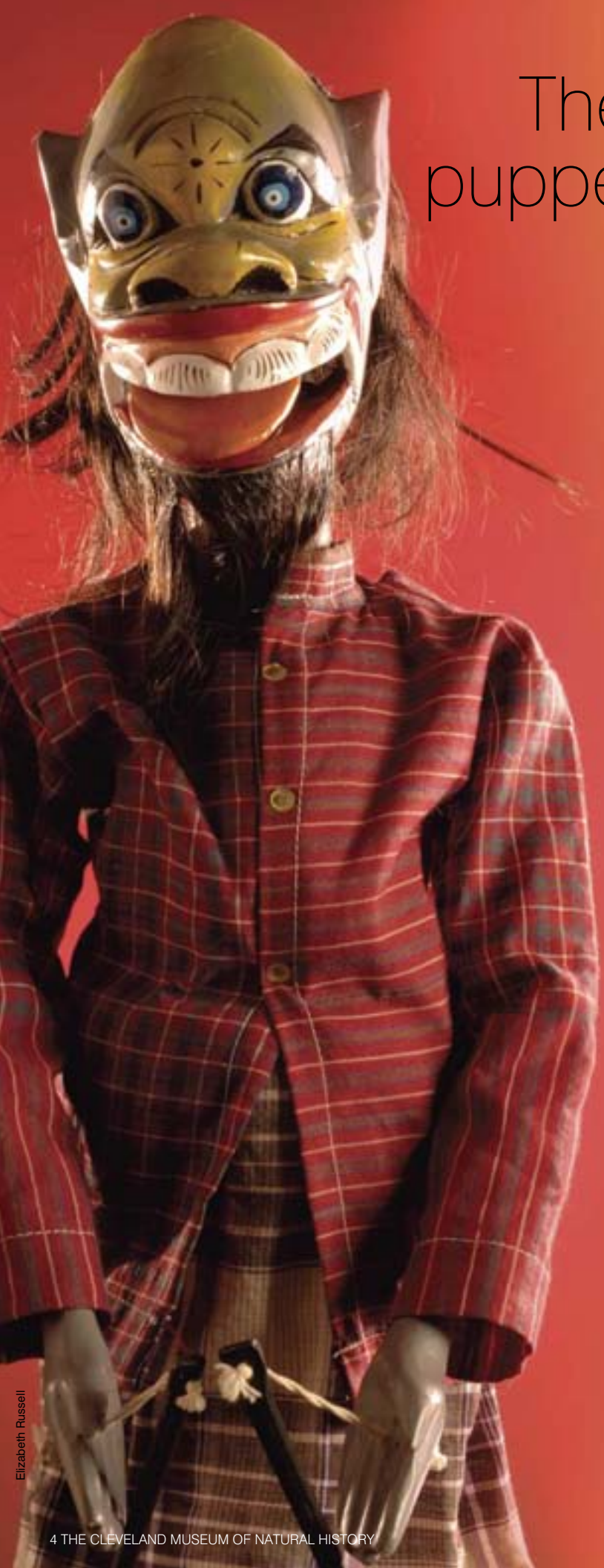
Why do we do this? Because collections provide records that we can refer to as we investigate new questions about our world. They allow us — and scientists from around the globe as well — to acquire new insights into life on our planet as it was in the past, as it is today and as it may be in the future.

This issue of *Explorer* magazine gives us an opportunity to showcase our collections — and research that involves collections — in a unique way. Read on in this issue to learn about objects from our collection and research at the Museum.

— Dr. Bruce Latimer, Museum Executive Director



Greg Petusky



Elizabeth Russell

Department of Cultural Anthropology

The *wayang golek* puppets of Indonesia

In the United States, the popular puppet characters Elmo, Cookie Monster and Oscar the Grouch entertain and educate children about literacy, math and social-emotional issues on the television show *Sesame Street*.

Similarly, in Indonesia, the puppet theater known as *wayang golek* serves to entertain the public and inform people about various issues. Since at least the 11th century, *wayang* (pronounced "why-young") *golek* has been used to convey religious and ethical messages. Around the mid-20th century, puppet performances began to include political messages as well.

In 2004, The Museum's Cultural Anthropology Department received 11 *wayang golek* puppets from Dr. John Hunter, a retired professor of art at Cleveland State University, and the late Alan Weissberg. They purchased the puppets in the 1990s in antiques shops in Jakarta.

On the island of Java, *wayang golek* was established around the 16th century to entertain the elite population. Starting in the 19th century, *wayang golek* performances were opened to the common people as well. Today, these performances take place at weddings, funerals, circumcisions and other life-related events.

Wayang means shadow, spirit or puppet and *golek* means rod in Javanese. A *dalang* brings the puppets to life, manipulating their movements while singing, narrating and speaking each character's voice. A *gamelan* orchestra, composed of gongs, drums and other percussion instruments, provides musical accompaniment and sets the mood of each scene.

Performances usually begin around 7:30 pm, end around 3:30 am, and take place outdoors. During the performance, people come and go as they please, socialize, eat and even sleep.

The two principal divisions of *wayang golek* theater are *wayang purwa* and *wayang cepak*. Both emerged in West Java and are based on the religions of Indonesia. *Wayang purwa* performances are based primarily on two Hindu Indian epics: the *Mahabharata* and the *Ramayana*. *Wayang cepak* performances emerged with the advent of Islam in Java and include stories about Amir Hamza (the prophet Mohammed's uncle) and Panji (an Indonesian legend).

Although they evolved from different religious traditions, the theme of good vs. evil — with the good characters always winning and justice prevailing — is common to both *wayang purwa* and *cepak* performances. Good characters differ physically from bad characters. With a few exceptions, the former are small, with long, slender bodies, almond-shaped eyes and fine features. The latter have large bodies and noses, bulging eyes and coarse facial features. Their teeth and gums are generally exposed.

The Hunter-Weissberg Collection contains excellent examples of these character types. A Javanese lady and nobleman display the traditional physical characteristics of good characters; ogres (giants and monsters) typify bad characters.

The collection also includes a few clowns, which represent the common person. These may play bad or good characters, but they generally have the physical characteristics of a bad character. In recent years, clowns have been used to speak about controversial contemporary Indonesian politics.

Today, the *wayang golek* theater remains strong in Indonesia, a reflection of the adaptability of this traditional art form in the face of modern influences.

— Adriann Balok,
Interim Associate Curator of Cultural Anthropology, and
Jennifer Primrose, Beloit College Anthropology Graduate

Department of Physical Anthropology

The Woranso-Mille paleontological site

Thirty years ago, Dr. Donald Johanson, then-Curator of the Museum's Physical Anthropology Department, was running a field project in Ethiopia's Afar region at a now-famous site called Hadar.

During this time, the Museum occupied the national and international spotlight repeatedly because of the 3 million-year-old fossils of early human ancestors his project had collected there, including the famous partial skeleton of the early human ancestor nicknamed "Lucy." Simultaneously, the Museum's Physical Anthropology Department was earning a reputation as one of the best laboratories in the world for research into human origins.

Today, history is repeating itself with the recovery of new — and even older — fossil remains of our ancestors from another site in the Afar Region.

A team co-led by Museum Executive Director Dr. Bruce Latimer and myself discovered the Woranso-Mille Paleontological Site in 2004 in the deserts of the Central Afar region. The site is about 325 miles northeast of the capital Addis Ababa and 25 miles east of a small town called Mille.

During its first field season, our team collected more than 600 fossil specimens of various animals, including 12 specimens representing an early human ancestor from 4 million years ago.

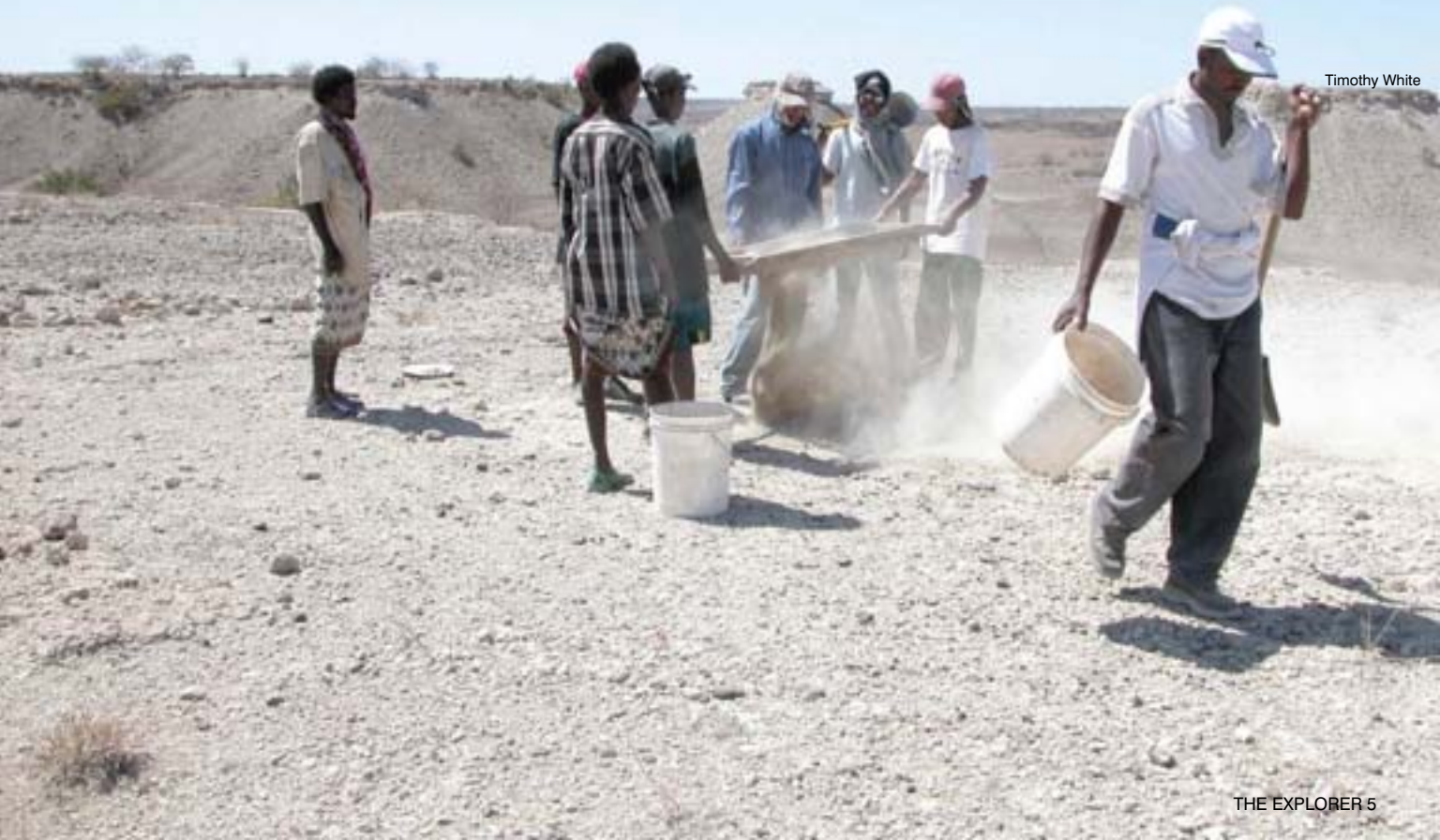
One of these specimens was the partial skeleton of a single individual, an extremely rare find in early hominid fossil hunting. It represents one of only four partial skeletons of early human ancestors older than 3 million years currently known in the history of paleoanthropology. During the initial excavation of this specimen, the team recovered numerous complete body parts, such as the tibia (lower leg), the pelvis (hip bone) and the scapula (shoulder blade).

Continued excavation of the partial skeleton site at Korsi Dora locality resulted in the February 2006 recovery of additional bone fragments that might join to make up a radius (one of the lower arm bones). Survey and exploration of other localities in the study area yielded additional fossil hominids, including associated upper and lower teeth, a partial mandible (lower jaw) fragment with dentition, and a maxillary fragment with teeth.

Excavation of the partial skeleton will resume during the 2007 field season in hopes of finding more elements. The new discoveries from the last field season, added to the previous discoveries, yield more information on the taxonomic status of the hominid specimens recovered from the site thus far. Preliminary radiometric dates have been obtained and more rock samples are currently being dated. Curation, preparation and subsequent analysis of the fossil hominids will start next summer for projected publication at the end of 2008.

Thanks to this new project, the international spotlight has returned to the Museum.

— Dr. Yohannes Haile-Selassie,
Curator of Physical Anthropology



Timothy White

The discovery of a giant arthropod trackway

Joe Hannibal

In June 2004, the New Mexico Museum of Natural History and Science invited this museum's Invertebrate Paleontology Department staff to join colleagues from the Carnegie Museum of Natural History and the Smithsonian on an expedition to El Cobre Canyon in north-central New Mexico.

On our second day at this remote location, our team made a long hike from base camp to promising deposits in search of fossil plants and arthropods, especially myriapods — millipedes, centipedes and their kin. These organisms are a specialty of our department.

A few years back, I described the occurrence of the giant, millipede-like arthropod *Arthropleura* from Ohio and Pennsylvania in the Museum's scientific journal *Kirtlandia*. I also published a nontechnical account of this and other finds of the giant arthropod in *Explorer* magazine in 1997, noting that *Arthropleura* was in the same ballpark, sizewise (2.5 meters, a little more than 8 feet long), as the giant ants in *Them!*, the classic 1954 monster movie.

The Ohio occurrence was found in Pennsylvanian-age rocks laid down about 300 million years ago. The rocks we were examining in New Mexico were about the same age.

But the pickings were slim on that second day at El Cobre, considering we had spent hours hiking up, down and along arroyos, and about eight hours searching for fossils. We found one decent, but hard to identify, piece of cuticle (the outer covering) from a large fossil arthropod that day. Initially, we thought it might be part of *Arthropleura*. (This specimen turned out *not* to be a myriapod.) Our colleagues did, however, recover a lot of plant material.

Day three was easy compared to day two. Our Cleveland Museum crew, consisting of longtime volunteer Bob Danielson and myself, joined Dan Chaney from the Smithsonian in splitting shale at a location much closer to our base camp in the canyon. I sat on a thick sandstone ledge and split shale for hours with Bob and Dan, examining each thin layer with care. We found lots of plants, but no myriapods.

In the afternoon, Dave Berman and Amy Henrici from the Carnegie Museum of Natural History happened to visit our site. As Dave approached from above, walking down to where I was sitting on the ledge, he said something to the effect of, "Look at that big trackway where you are sitting."

I replied skeptically with something like "Oh sure." However, I stood up and there was, indeed, a giant trackway near where I had been sitting! And on the same thick sandstone bed! I hadn't been able to see it from my seated position.

The trackway (shown at left) consisted of two well-preserved parallel rows of roughly crescent-shaped footprints. It was 37 centimeters (14.5 inches) wide by my field measure and 38 centimeters (about 15 inches) wide by later measurement — one of the very largest such trackways.

Colleagues, including Alan Lerner, from the New Mexico Museum recognized this as soon as they saw the specimen. The trackway, which we assigned to the trace-fossil species *Diplichnites cuithensis* in a technical report, was made by *Arthropleura*. This turned out to be the first evidence for *Arthropleura* in the southwest United States.

We left our specimen in the field, since it was on the large — not to mention heavy — side. The New Mexico Museum returned to the site in spring 2005 to collect it. It's now on display, along with a large plastic model of *Arthropleura*, at that museum.

One last thing. It is likely that similar trackways will eventually be found in Ohio. Our state has lots of rocks of the right age, and we already have fossil evidence that *Arthropleura* was here.

— Dr. Joe Hannibal, Curator of Invertebrate Paleontology

Bone points from Sheriden Cave

In summer 1997, Museum archaeologists participated in the excavation of one of Ohio's most important archaeological sites: a small cave at the bottom of a sinkhole in Wyandot County known as Sheriden Cave.

In addition to the remains of more than 60 species of Ice Age animals, the cave contained ancient, human-made tools: a large flint hide-scraping tool, a small fluted spear point and two complete bone spear points. Radiocarbon dating of the artifact-bearing layer revealed that Ohio's first inhabitants, the Paleoindians, had made these tools between 10,600 and 10,900 years ago.

Since virtually all of the Paleoindian artifacts known from the Midwest are stone tools, this discovery of bone artifacts was of great significance. So, in cooperation with my colleague Dr. Ken Tankersley (now of Northern Kentucky University), we began an in-depth study of these rare objects.

We carefully examined the bone points and realized that they were made from fragments of animal limb bones. Scraping and grinding marks on the shaft of each one revealed that they had been manufactured with flint tools and perhaps finished with sandstone. The distinctive angular bevels at the ends of each specimen were covered with deep, overlapping incisions made with a flint flake knife. Such scoring was probably used to roughen the surface of the bevel before joining it with the alternate bevel of a wooden spear shaft or handle.

Scanning electron micrographs of the tip of one bone point revealed impact damage that most likely resulted from being used on the end of a spear. We are now nearly convinced that these artifacts were used as projectiles, rather than as daggers, foreshafts or leather punches.

To learn what species of animal these points were made from, we X-rayed the tibiae (lower leg bones) of a caribou, elk, moose and bison. Of these, only the bison leg bone, taken from the largest male bison in the collection of the Illinois State Museum, had enough outer (cortical) bone to make bone shafts as thick as ours.

These results indicate that the bone points were probably made from splinters of long bone from an animal of bison size or larger. During the Ice Age, this could have been a mammoth, mastodon, musk ox, stag-moose or giant ground sloth.

In the end, our examination of the human-made tools from Sheriden Cave revealed that the Paleoindian cave dwellers stayed briefly and lived very simply. Among the thousands of animal bone fragments found inside the cave, only one bone, the neck vertebra of a snapping turtle, shows small cut marks from butchering. A few handfuls of burned bone may indicate that small fires were made, perhaps to cook the turtle. Some tiny flint flakes suggest that a limited amount of stone tool-making went on.

But the four unbroken, still-usable prehistoric artifacts found within a 1-meter-wide area at the back of the cave suggest that prehistoric hunters deliberately stored these weapons and tools at this spot. In historic times, Arctic hunters were known to make such "insurance caches" to be used in times of need. Perhaps Sheriden Cave was a similar kind of way station for the Late Ice Age hunters of Ohio.

— Dr. Brian Redmond, Curator of Archaeology

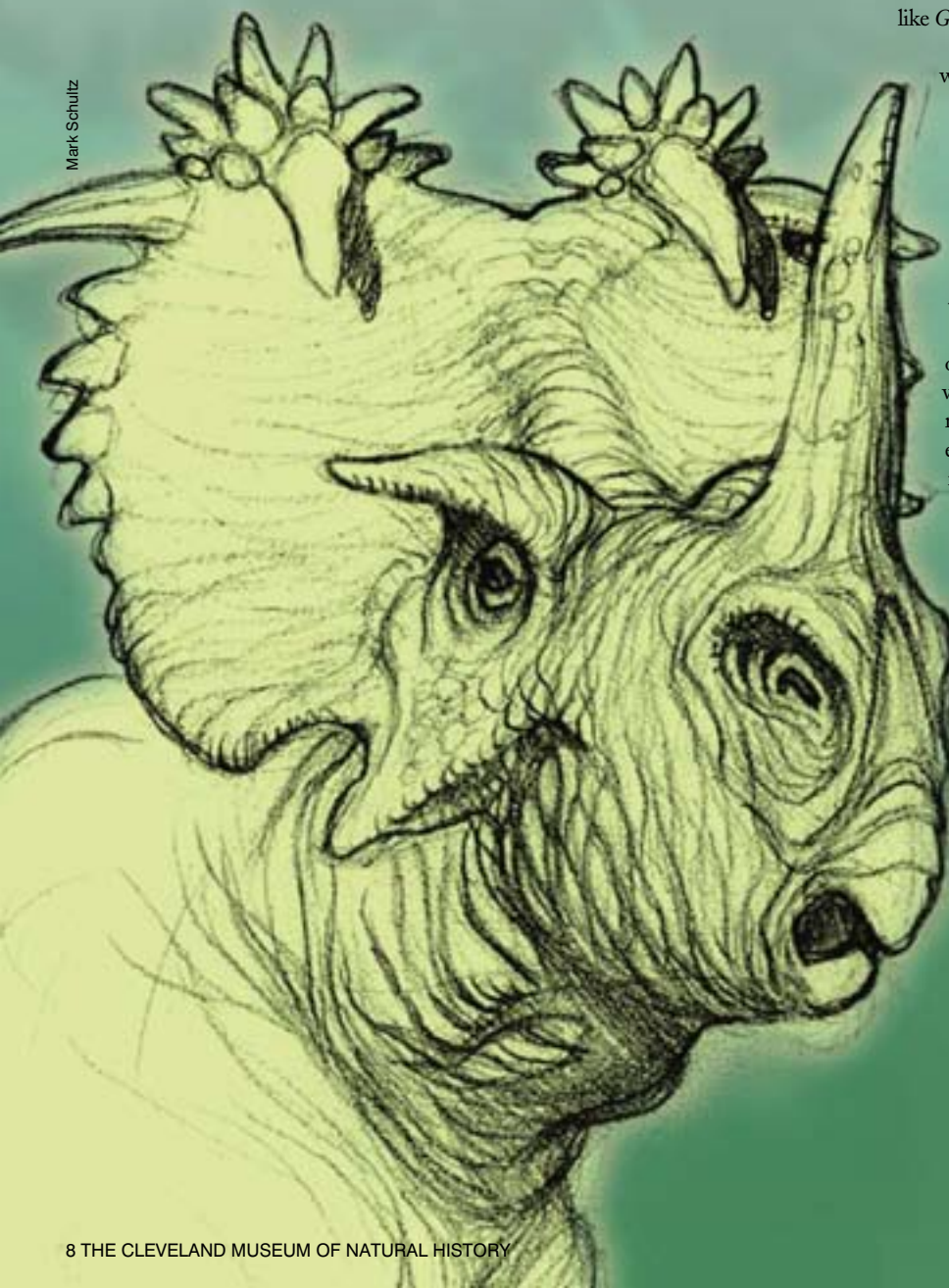
Greg Petusky

A new species of Ceratopsian

In November 2005, University of Calgary Professor of Zoology Dr. Anthony P. Russell and I published a paper that described a new species of horned dinosaur, *Centrosaurus brinkmani*.

This dinosaur belongs to the family Ceratopsidae ("horned-face"), a group that includes such well-known members as *Triceratops* and *Styracosaurus*. All the dinosaurs in this family were four-footed plant-eaters that typically had unique ornamentation on their skulls that individual species probably used to recognize each other and select mates.

Centrosaurus brinkmani had a large, straight horn over its nose, short horns that extended sideways over its eyes from the brow and a series of odd, short, spikelike clusters that ringed the back margin of the frill. Additionally, it had two short hooks that curled forward over the top of the frill in a fashion similar to that of *Centrosaurus apertus*, the other species in the genus *Centrosaurus*.



Mark Schultz

Geographically, *Centrosaurus brinkmani* is only known from two localities in the world, both in southern Alberta. Each of these is a bone bed that contains thousands of fossilized bones.

The primary source for the new material comes from Dinosaur Provincial Park, a UNESCO World Heritage Site. Hundreds of people worked at the bone bed over six field seasons as participants in a field program that I and collaborators at the Royal Tyrrell Museum organized. Preparation of the bones was done by hundreds of volunteers who contributed thousands of hours.

Centrosaurus brinkmani roamed the western margin of the vast Western Interior Seaway that covered the middle of North America from the Gulf of Mexico to the Arctic Ocean during the late Cretaceous about 76 million years ago. This region was a broad, subtropical floodplain that *Centrosaurus brinkmani* shared with other horned dinosaurs such as *Chasmosaurus,* a variety of duck-billed dinosaurs including *Corythosaurus* and *Gryposaurus*, tyrannosaurs like *Gorgosaurus* and small "raptors" such as *Dromaeosaurus*.

The bone beds from which *Centrosaurus brinkmani* was recovered represent the disarticulated remains of at least hundreds, and possibly tens of thousands, of these dinosaurs that probably drowned. This suggests that *Centrosaurus brinkmani* lived together in large herds for at least part of the year.

Sedimentological evidence indicates that tsunami-like wave surges periodically swept the great floodplain. These would have drowned anything living in the area and led to the formation of the bone beds.

Centrosaurus brinkmani occurs in stratigraphically older rock strata than *Centrosaurus apertus*. Preliminary work I've done suggests that these two species may represent an occurrence of anagentic evolution, the direct evolution of one species into another, rather than the more typical "branching" hypothesis of speciation.

Anagentic evolutionary events are difficult to support from the fossil record. However, the ceratopsid fossil record in southern Alberta provides an unusually robust data set (thousands of fossil bone specimens from dozens of stacked *Centrosaurus* bone beds in a narrow geographic region) that will allow us to further explore this idea.

— Dr. Michael Ryan,
Curator of Vertebrate Paleontology

A new way to assess stream health

For years, biologists have used invertebrates and fish to evaluate a stream's water quality and the condition of its watershed (the terrestrial habitats through which the stream flows). Although these groups of animals remain essential to assessing water quality and biodiversity issues, the importance of stream-inhabiting salamanders, and more specifically their larvae, has begun to receive long-overdue attention.

The Ohio Environmental Protection Agency has established protocols for researchers to follow in the field. These not only provide data concerning which species of salamanders are present, the number of species present (species richness) and the abundance of each one, but they also allow these data to be compared between headwater streams.

These data also allow researchers to classify stream communities as ephemeral, warm water- or cold water-adapted biotic communities — designations allowed under the Clean Water Act — and to determine stream and watershed quality. Repeating these studies over time using the same protocols generates qualitative data (presence/absence) and, more importantly, quantitative data (numbers of individuals of a species and the relative number present in various size and age cohorts) that researchers can use to create a picture of stream and watershed stability.

The Lake County Soil and Water Conservation District has been using these OEPA protocols on first-order headwater streams in Lake County for more than five years. In the process, they've collected hundreds of amphibian specimens for in-house identification and verification. These have been deposited at the Museum as voucher specimens — specimens that document the occurrence of a species at a geographic locale at a point in time.

By accepting voucher specimens, whether they've been collected by Museum staff, private researchers or private or public organizations, we are able to add valuable new research material to our collections. As the size and scope of these collections grow, so does their research value to the scientific community and the general public as well.

— Dr. Timothy Matson, Curator of Vertebrate Zoology

Greg Petusky

Elizabeth Russell

Wildlife Resources Division

The story of George

George is a male Bald Eagle who turned 5 years old this year. Obtained from the Carolina Raptor Center, George was originally a gunshot victim, suffering bone-shattering wing injuries and damage to his left eye. The CRC repaired the wing and restored him to flight, but blindness in his eye prevented his return to the wild.

George came to the Museum in the fall of 2002. He was totally wild, stressed by his captivity. Fearful of humans, he was given to thrashing about his enclosure, inflicting additional injury to himself because of his poor depth perception.

George has been trained by Wildlife Center staff and master falconer Lou Gaeta. He has been "manned," a falconer's term reflecting his conditioning and acceptance of being on a gloved human hand. The painstaking process by which he reached this point involved months of patient confidence building and trust between George and the staff here. Every day, he has been fed on the gauntlet, reinforcing the contract between eagle and handler.

Once George was comfortable with wildlife staff, he was taken around the grounds of the Museum on the glove. First, he was first introduced to small groups of people, then small classes and gradually to larger and larger audiences.

With his molt this past summer, George gained adulthood. He became bald.

Actually, Bald Eagles are not really bald. Their name bald-headed eagle was coined at a time when "bald" meant "white" rather than hairless. The name "bald-headed" or "white-headed eagle" was then contracted to Bald Eagle. His scientific name, *Halieetus leucocephalus,* means "white-headed sea eagle."

George now sports a white head, brown body and white tail. His beak is yellow and his eyes are a pale straw color. Some slight streaking in the white feathers of the head and tail and a trace of an eye streak belie his status as having just come of age. That streaking will disappear in successive molts over the next several years. From that point on, it becomes impossible to determine the age of a Bald Eagle by plumage.

The process of attaining the characteristic Bald Eagle plumage — dark body, snow-white head and tail and conspicuous orange-yellow beak — takes four to five years. In the first year of life, an eagle's body is all brown, with the only white being found in the wingpits and the tail. Even the beak and the eyes are dark brown. In their second year, they have extensive white mottling on the underwings, back and belly, but the head is still dark. In the third and fourth years' molts the head and tail become increasingly white with a pronounced streak through the eyes flaring to the nape.

The last 14 months have marked George's official debut as a wildlife ambassador for the Perkins Wildlife Center and the Museum. He's been used on campus in live animal programs and classes taught here. He's made appearances in events at the Smead Discovery Center. Offsite, George has been showcased at Fall for the Circle events on Wade Oval. He's appeared at the Wildlife Festivals at Lake Metroparks and has been seen at Dike 14 Environmental Education Events on the Cleveland lakefront. He was also seen by more than 7,000 people at the Burning River Festival at Wendy Park on Whiskey Island last August. That event saw his photo featured in *The Plain Dealer.*

All in all, since October 1, 2005, George has been seen by more than 20,000 adoring fans — which just proves that bald is beautiful!

— Harvey Webster,
Director of the Wildlife Resources Division

Department of Invertebrate Zoology

The moth survey project on Kelleys Island

Good scientific collections tell a story. Since 1999, an ongoing project within the Department of Invertebrate Zoology has focused on building a collection of moths found on Kelleys Island that we can use to document changes that might be occurring there — particularly detrimental ones.

Kelleys is a 5-square-mile limestone island located 4 miles north of the Marblehead Peninsula. This location offers a unique opportunity for collecting moths.

There are many moth species on the island. To date, more than 300 of them have been collected by Museum Associate Barbara Coleman and identified by Research Associate James Ciha.

Some of these species, such as the Black Witch, have 6-inch wingspans. Others with no common names have wingspans no bigger than the common housefly. Many are bland in color. Others are distinctively hued, such as the "underwings," a group with flashy orange and yellow stripes on their hind wings that are exposed only during flight.

When an ecosystem is disturbed — either as the result of a natural disaster, such as a flood, or devastating human activity, like the construction of a housing development — the plant life responds. Some native species die out. Other species, many of which are invasive, non-native and weedy, take advantage of the opportunity to dominate. Ultimately, plant species diversity declines.

As the plant community changes, so does the moth community. Most moths prefer particular "host plants," upon which the adult females lay eggs and the larvae feed. Just a few are general detritivores — that is, they eat decaying organic materials.

Using moth collections can be an inexpensive means of monitoring ecosystem changes. Coleman uses a black-light trap and a bait trap to collect night-flying moths from April to October. In the Entomology Lab, Ciha mounts them on insect pins, spreads their wings and identifies them.

The dates of collection and species composition information have been compiled into a database for analysis. After seven years, we are close to producing a reliable inventory of moth species on Kelleys Island. Future collecting will reveal evidence of change over time in species composition and population.

What will the moths reveal about Kelleys Island? Only time — and the continued efforts of Coleman and Ciha — will tell.

— Dr. Joe Keiper, Curator of Invertebrate Zoology

Greg Petusky

Elizabeth Russell

Finding rose pogonia at Singer Lake

The beauty of working to protect an intact habitat like Singer Lake, a 1.25-mile-long bog complex in Summit County, is that you've preserved its potential to surprise you. Since I first set eyes on the location in 1989, each field season has revealed something unexpected and, usually, wonderful.

I'd always wanted to find rose pogonia (*Pogonia ophioglossoides*) on one of our natural areas. This beautiful native orchid is Threatened in Ohio and five other states. Admittedly, it was rare here even before Ohio was settled, because it only grows in bogs and fens. But it is even rarer today.

When we found rose pogonia at Singer on June 16, 2005, my volunteers and I were actually looking for another rare orchid, lily-leaved twayblade. We'd found this species at Singer the year before, and we'd chosen this date specifically because we knew lily-leaved twayblade should be blooming.

It was near the end of the day when I suggested we look in Marianne's Bog. This is one of my favorite bogs at Singer, because it's home to the Elfin Skimmer dragonfly and a host of other neat living creatures.

We hadn't been in the bog for more than a few minutes when we spotted a little mossy hummock, seven or eight inches across, surrounded by water. I noticed that there were buds on part of it and, on one edge, a rose pogonia in full bloom.

I sent word to have photographers Elizabeth Russell (Museum staffer) and Judy Semroc (volunteer) drive down to Singer to document the find. Rose pogonia is a distinctive orchid — it stands 12 to 15 inches high, has between one and three slender leaves and bears a pale rose-colored flower that nods slightly and has the scent of red raspberries. It was a pleasant surprise when they returned to tell me that they'd found three more plants in flower in a field of sphagnum while they were there.

Unfortunately, as development has claimed Ohio's best bogs, it also has eliminated habitat for rose pogonia (Geauga Lake, which actually used to be a bog, was once a terrific place to find this orchid — not so today). Singer is now considered the largest bog remaining in the state, so to find an established population of this plant here is good news.

I should add that on the day we found rose pogonia at Singer, we did find lily-leaved twayblade, too. And while we were looking for more twayblade, we got one more surprise. One of my volunteers found a large stand of yet another orchid, whorled pogonia, which hadn't before been found at Singer.

We've now confirmed that there are nine species of orchid growing at Singer.

— Dr. James Bissell, Curator of Botany and Director of the Center for Conservation & Biodiversity

Department of Paleobotany

The clubmoss forest of the Late Devonian

Since 1980, much of my research has focused on describing the unique forest that thrived on the marshy coast of Northeast Ohio 363 million years ago. This work has been possible thanks to the Museum's world-renowned collection of plant fossils recovered from the Upper Devonian Cleveland Shale, especially those collected during the construction of Interstate 71 through Greater Cleveland.

Because specimens of tree-sized clubmoss stems (axes) and cones dominate the fossils in this collection, this ancient forest has become known as a "clubmoss forest." However, it contained a variety of forms of vegetation that thrived on the land adjacent to the warm, shallow Ohio Sea in the equatorial climate of the time.

Patches of algae populated the wet forest floor. These included a kelplike marine alga, *Prototaxites clevelandensis*, which I identified as a new species in 1992, and a brown thalloid alga, *Protosalvinia*, which I will formally identify in a forthcoming paper.

Early ferns inhabited the forest undergrowth, as did a slender, unbranched clubmoss (lycopsid) that had rootlike structures at the base and a straight cone at the tip that produced two types of spores (heterosporous). This new genus and species, *Clevelandodendron ohioensis*, which I described with Dr. Kathleen Pigg in 1996, is unique in the world. The international scientific community agrees that this plant displays the origins of heterosporous reproduction and vertical growth habit in lycopsids.

Another herbaceous Late Devonian lycopsid, which we know from a short piece of permineralized (petrified) branch with an apical cone found in the Cleveland Shale, displayed advanced characteristics in its internal tissues. Such characteristics were previously seen only in big lycopsid trees of Pennsylvanian age, which developed secondary tissues. In 2004, I and colleague Dr. Cheng-Sen Li identified it and named this new genus and species *Smeadia clevelandensis*.

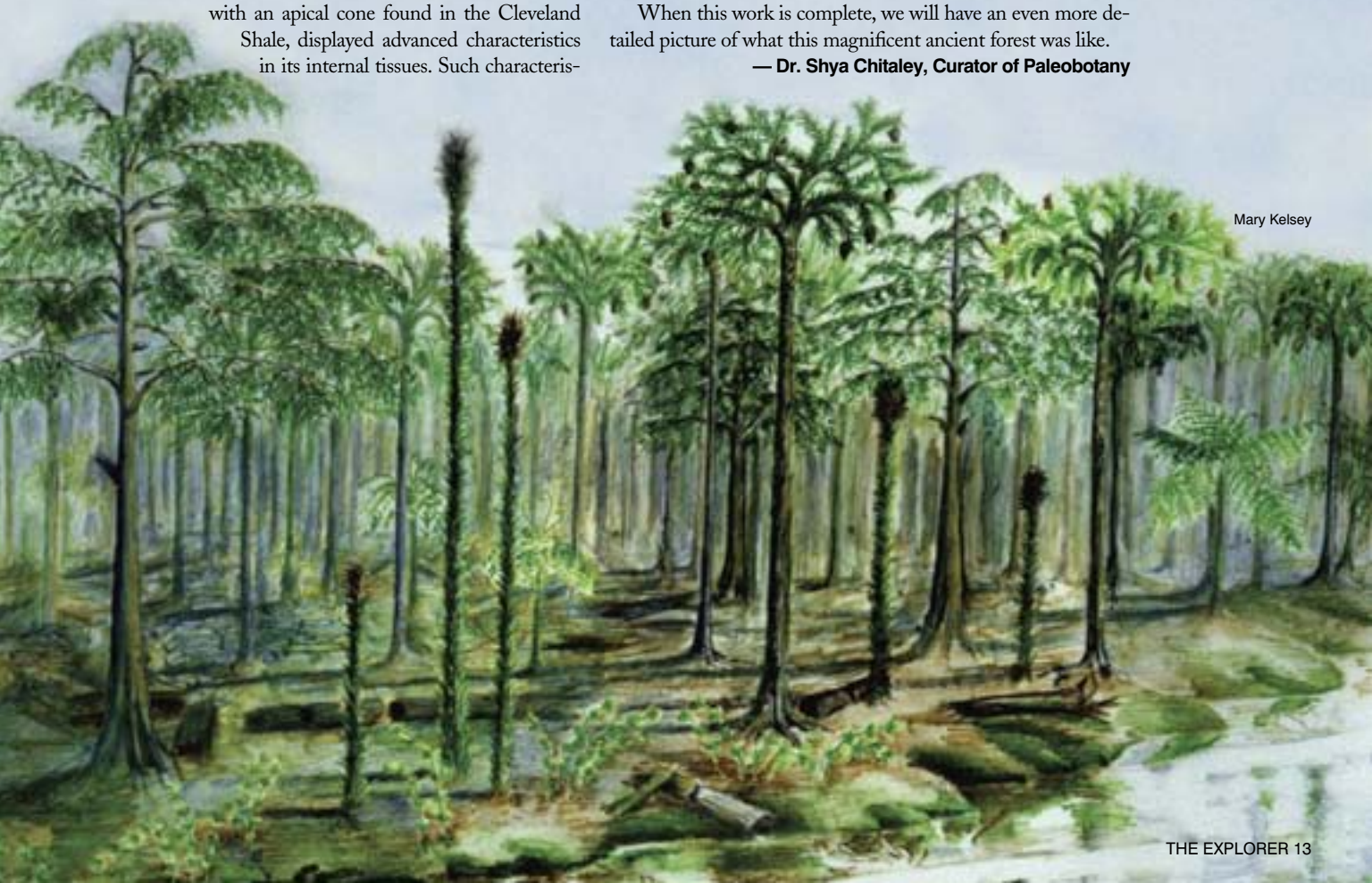
Other treelike plants reached for the sky in this Late Devonian forest. Among them were progymnosperms — primitive woody trees that relied upon spores, not seeds, to reproduce. Examples include *Callixylon clevelandensis*, which I identified in 1987, and *Callixylon beckii* (identified from the Cleveland Shale) and *Callixylon huronensis* (identified from the Late Devonian Huron shale), which I named with colleague Dr. Chongyang Cai in 2001.

There is no doubt that clubmosses dominated Ohio's oldest native forest. My research now is focused on identifying the clubmoss genera and species that existed. I have separated about a dozen compressed cones and more than a dozen axes for detailed study. All differ from each other, which indicates that there were at least a couple dozen different clubmoss trees present.

I recently presented a paper defining a new clubmoss genus, *Arnoldia*, and the species *A. gaulii* and *A. clevelandensis* (both from the Cleveland Shale) as well as *A. gallowayi*, a synonym for the old name, *Lepidostrobus gallowayi*, described by Dr. Chester Arnold in 1933 from Pocono sandstone of Mississippian or perhaps Upper Devonian origin. Superficially, all these cones look alike. But a more detailed examination reveals differences in the size, shape and structure of their sporophylls (spore-bearing structures) and the most important characteristic: spores.

When this work is complete, we will have an even more detailed picture of what this magnificent ancient forest was like.

— Dr. Shya Chitaley, Curator of Paleobotany



Mary Kelsey

Moissanite: a different diamond simulant

In 1998, Bluestone Trading Company donated a 0.6-carat (5.5 mm) round-cut synthetic moissanite to the Department of Mineralogy. This acquisition was the first specimen of this gemstone in the collection.

Moissanite (pronounced MOY-san-nite) has been available to the general public since 1997. In that time, it has captured attention for being nearly identical to diamond in appearance, except for its greater dispersion (an optical property often referred to as "fire").

Around 1894, French chemist Dr. Henri Moissan (1852-1907) discovered the substance in fragments of Arizona's Diablo Canyon meteorite. At first, he thought the mineral was diamond. After years of analysis, Moissan found that it was actually an extremely rare occurrence of natural silicon carbide. In 1905, the mineral was named *moissanite* in his honor. (The next year, Moissan won a Nobel Prize in chemistry for isolating fluorine and developing the electric-arc furnace.)

Natural moissanite is much rarer than diamond — so much so that it must be manufactured to acquire pieces large enough for faceting. It has a silicon-carbide chemical composition close to that of carborundum, a synthetic abrasive material discovered in 1891. In the late 1980s, Cree Research Inc. of Durham, North Carolina, developed a process that allowed single crystals of silicon carbide to be created that were large enough to cut. In 1997, a spin-off company, C3 Inc. (known today as Charles & Colvard), introduced this lab-created moissanite to the jewelry industry as a substitute for diamond.

Synthetic moissanite is very close to diamond in its physical properties, much closer than other synthetic gemstones, such as cubic zirconia, synthetic spinel, colorless sapphire and YAG (yittrium aluminum garnet). On the Mohs scale (a scratchability test from 1 to 10), it has a hardness of 9.25; on the Knoop scale (an indentation hardness test), it has a hardness of 2,917 to 2,954 kg/mm^2. For comparison, a diamond has a Mohs hardness of 10. However, moissanite has a much higher refractive index (a measure of brilliance) — 2.65 to 2.69 — and dispersion — .104 — than diamond, 2.42 and .044, respectively.

Moissanite also shares diamond's ability to transmit heat, a characteristic that has traditionally been used to identify fake diamonds. However, an experienced gemologist can use several other physical clues to tell moissanite from diamond, including examining a stone for needlelike inclusions and testing whether it absorbs ultraviolet light. In natural light, large moissanite stones have a faint gray to green tint.

In the past year, new laboratory-generated stones have come on the market that are actually real diamonds. Some of these are much less expensive than moissanite, which remains artificially high at about 1/10 the cost of natural diamond.

However, none of these has moissanite's brilliance. This characteristic is so distinctive that moissanite deserves to be considered a gemstone in its own right.

— Dr. David Saja,
Curator of Mineralogy

Elizabeth Russell

The ultimate gift that keeps on giving

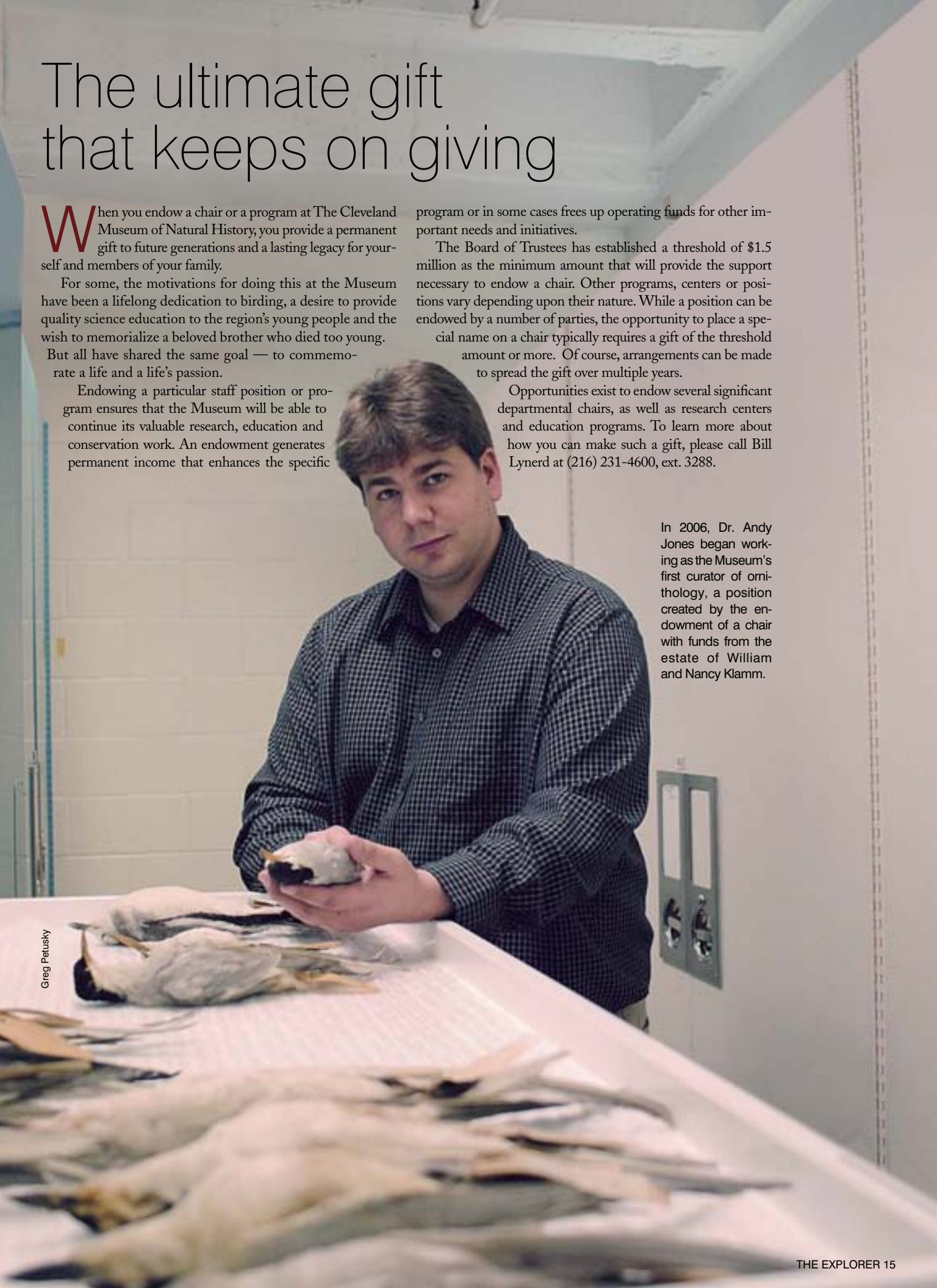
When you endow a chair or a program at The Cleveland Museum of Natural History, you provide a permanent gift to future generations and a lasting legacy for yourself and members of your family.

For some, the motivations for doing this at the Museum have been a lifelong dedication to birding, a desire to provide quality science education to the region's young people and the wish to memorialize a beloved brother who died too young. But all have shared the same goal — to commemorate a life and a life's passion.

Endowing a particular staff position or program ensures that the Museum will be able to continue its valuable research, education and conservation work. An endowment generates permanent income that enhances the specific program or in some cases frees up operating funds for other important needs and initiatives.

The Board of Trustees has established a threshold of $1.5 million as the minimum amount that will provide the support necessary to endow a chair. Other programs, centers or positions vary depending upon their nature. While a position can be endowed by a number of parties, the opportunity to place a special name on a chair typically requires a gift of the threshold amount or more. Of course, arrangements can be made to spread the gift over multiple years.

Opportunities exist to endow several significant departmental chairs, as well as research centers and education programs. To learn more about how you can make such a gift, please call Bill Lynerd at (216) 231-4600, ext. 3288.

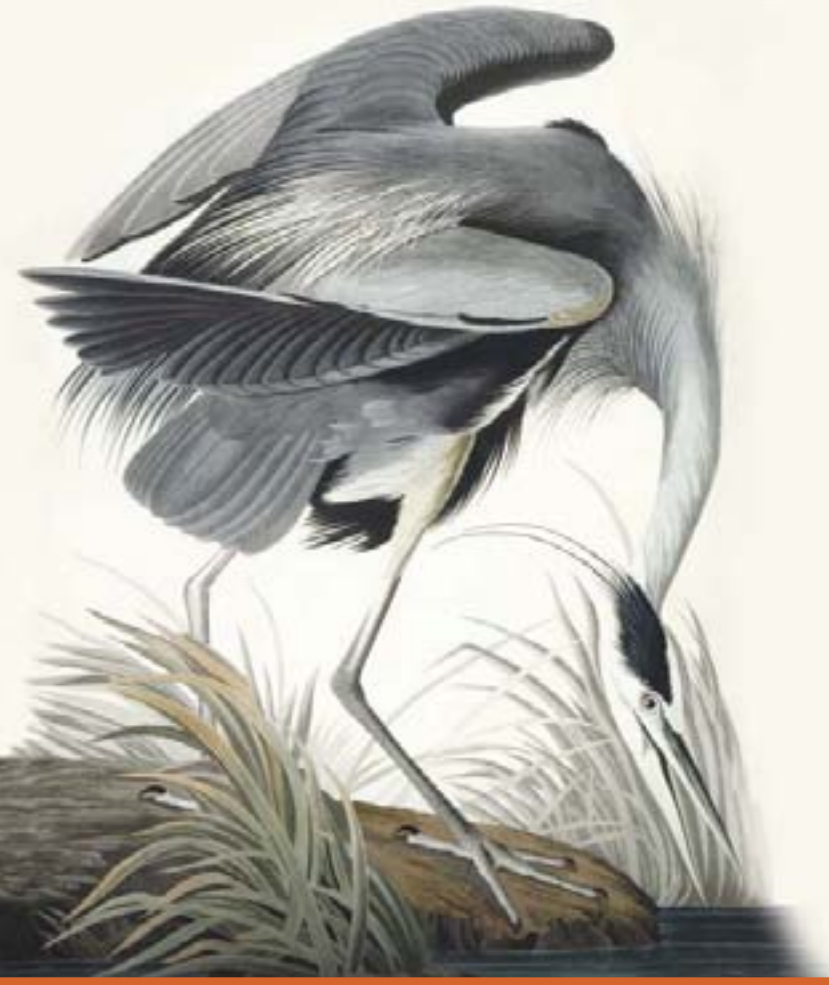


In 2006, Dr. Andy Jones began working as the Museum's first curator of ornithology, a position created by the endowment of a chair with funds from the estate of William and Nancy Klamm.

Greg Petusky

Explore the Museum this spring

and enjoy these exhibitions:



A *T. Rex* Named Sue

Through April 15

Sue is the largest, most complete and best preserved *Tyrannosaurus rex* ever unearthed. Don't miss this unique opportunity to see the spectacular, full-sized cast of this dinosaur's 42-foot-long, 12-foot-high skeleton and learn more about its intriguing past. This informative, interactive exhibition explores the paleontology that has helped scientists reconstruct Sue's life and legacy.

This exhibition was created by The Field Museum, Chicago, and made possible through the generosity of McDonald's Corporation. It is presented in Cleveland with the support of The Ford Motor Company and Giant Eagle. Promotional sponsors include McDonald's Owners/ Operators of Northeastern Ohio, *Cleveland Magazine, The Plain Dealer,* WVIZ/WCPN ideastream, 105.7 WMJI, 99.5 WGAR, 106.5 WMVX and WEWS NewsChannel 5.

John James Audubon: American Artist and Naturalist

Through April 29

John James Audubon has come to symbolize wildlife conservation and the spirit of the American frontier. Learn about the life and work of this self-taught artist who rose to international fame and created a body of work that set a standard against which all bird artists are still measured. See more than 50 magnificent hand-colored engravings from Audubon's *The Birds of America,* prints from his *Imperial Folio of the Quadrupeds* and more.

EXPLORER

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