

## **INSPIRING GENERATIONS THROUGH KNOWLEDGE AND DISCOVERY: NEW RESEARCH**

Highlights of some of many new Smithsonian research initiatives have been prepared by Under Secretary for Science Eva J. Pell and Under Secretary for History, Art, and Culture Richard Kurin. Time permitting, the Under Secretaries will provide brief oral summaries of the following papers to the Board at its January 25, 2010, meeting.

- A. Highlights of New Science Discoveries, Research Programs, and Initiatives**
- B. Research in History, Art, and Culture: East Meets West**

## **INSPIRING GENERATIONS THROUGH KNOWLEDGE AND DISCOVERY**

### *Highlights of New Science Discoveries, Research Programs, and Initiatives*

The work of Smithsonian scientists is essential to the Institution's ability to meet the four grand challenges of the Smithsonian Strategic Plan: understanding and sustaining a biodiverse planet, unlocking the mysteries of the universe, valuing world cultures, and understanding the American experience. The following stories highlight a few of the many new discoveries, research programs, and initiatives that have occurred recently at the Smithsonian. These achievements reflect the immense resources and intellectual talent of the Smithsonian, as well as demonstrate its commitment to addressing issues and answering questions of global importance.

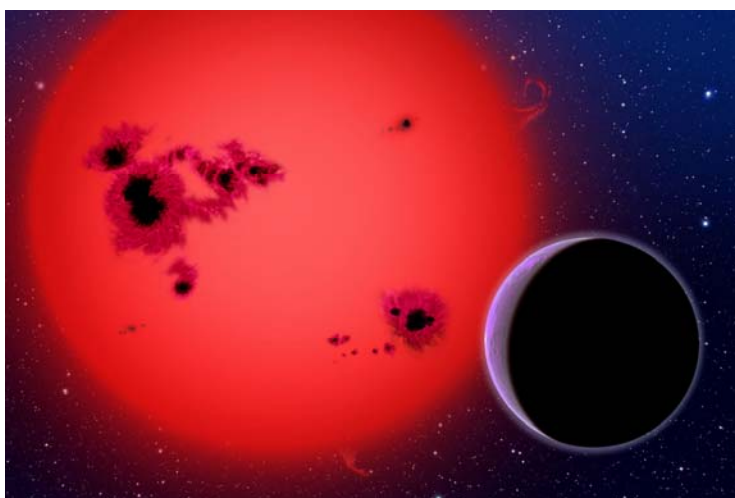
### **UNLOCKING THE MYSTERIES OF THE UNIVERSE**

#### **Astronomers at the Smithsonian Astrophysical Observatory (SAO) Find Super-Earth Using Amateur Technology**

Astronomers at SAO have discovered a "super-Earth" orbiting a red dwarf star 40 light-years from Earth. They found the distant planet with a small fleet of ground-based telescopes no larger than those many amateur astronomers have in their backyards. Although the planet is too hot to sustain life, the discovery shows that current ground-based technologies are capable of finding almost-Earth-sized planets in warm, life-friendly orbits.

A super-Earth is defined as a planet between one and 10 times the mass of the Earth. The newfound world, GJ1214b, is about 6.5 times as massive as the Earth. Its host star, GJ1214, is about one-fifth the size of the Sun, has a surface temperature of only about 4,900 degrees Fahrenheit, and emits a luminosity just three-thousandths as bright as the Sun.

This artist's conception shows the newly discovered super-Earth GJ 1214b, which orbits a red dwarf star 40 light-years from Earth. It was discovered by the MEarth project—a small fleet of ground-based telescopes no larger than those many amateur astronomers have in their backyards.



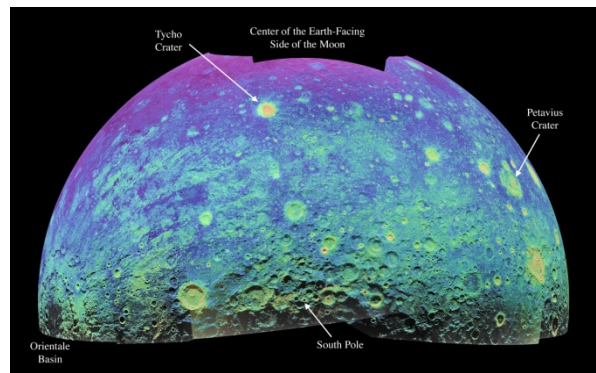
The planet GJ1214b orbits its star once every 38 hours at a distance of only 1.3 million miles. Astronomers estimate the planet's temperature to be about 400 degrees Fahrenheit. Although warm as an oven, it is still cooler than any other known transiting planet because it orbits a very dim star.

Since GJ1214b crosses in front of its star, astronomers were able to measure its radius, which is about 2.7 times that of the Earth. This makes GJ1214b one of the two smallest transiting worlds astronomers have discovered. The planet's density suggests that GJ1214b is composed of about three-fourths water and other ices, and one-fourth rock. There are also hints that the planet has a gaseous atmosphere.

### **National Air and Space Museum (NASM) Geologist Makes a Radar Map of the Moon**

A Smithsonian geologist is using the Greenbank telescope system in West Virginia to make radar maps of the moon.

Dr. Bruce Campbell can direct the Greenbank telescope, which is more than 300 feet wide, towards any spot in the sky. The telescope receives radar echoes that are bounced off the moon by signals transmitted from the Aricebo telescope in Puerto Rico. The echoes can penetrate the dirt- and dust-covered surface of the moon to create high-resolution images that can show features as deep as 100 feet below the moon's surface. Scientists also have seen ancient geological features such as lava flows.



Making radar maps of the moon allows scientists to understand its basic geology. The moon also preserves a geological record of a time in the history of the solar system going back more than 3 billion years—a record that is almost entirely erased on the Earth

because of erosion. In addition, scientists can study ancient volcanism, the role of impacts in the sculpting of the moon's surface, and a variety of other geological issues.



The maps also provide basic information on the surface and subsurface properties of the moon, which are needed to prepare for robotic and human exploration. By using this technology, Smithsonian scientists can look down into the lunar soil and back in time.

NASM scientists use radar echoes that are bounced off the moon and received by the Greenbank telescope system in West Virginia to see below the moon's surface.

## UNDERSTANDING AND SUSTAINING A BIODIVERSE PLANET

### National Museum of Natural History (NMNH) Biologist Discovers New Species of Giant Rat Discovered in Volcano Crater

A Smithsonian biologist discovered a new species of giant rat on a filmmaking expedition to a remote rainforest in Papua New Guinea. The discovery was made in the crater of the extinct volcano Mount Bosavi in Papua New Guinea's Southern Highlands province. Two-and-a-half miles in width and rimmed with walls nearly a half-mile high, the gigantic volcano's crater trapped the creatures inside a "lost world" of mountain rainforests probably rarely visited by humans.

Kristofer Helgen, curator of mammals at NMNH, was one of the first on the scene when the rat was found by a tracker from the Kasua tribe that lives outside the crater.



"It is a true rat, closely related to the rats and mice most of us are familiar with, but so much bigger," said Helgen.

Weighing nearly 3.5 pounds and measuring 32 inches from nose to tail, the Bosavi woolly rat is one of the biggest rats in the world. Most surprising is that the rat is completely tame, a sign that the animals in the isolated crater are unfamiliar with humans.

The gigantic rat is silvery gray, with thick woolly fur. It eats a vegetarian diet of leaves and roots and probably builds underground nests beneath rocks and tree roots. A member of the genus *Mallomys*, it has yet to receive its formal scientific name.

The expedition also found approximately 16 species of frogs, one species of gecko, three species of fish, and at least 20 species of insects and spiders—

potentially all new species. Also on the list is an animal Helgen calls the Bosavi silky cuscus, which may be a new subspecies of the tree-living marsupial.

### NMNH Researchers Identify Largest Orb-Weaving Spider

Researchers from NMNH and colleagues in Slovenia have identified a new giant *Nephila* species (golden orb weaver spiders) from Africa and Madagascar. Smithsonian research associate Matjaž Kuntner, along with Jonathan Coddington, senior scientist and curator of arachnids in NMNH's Department of Entomology, determined size differences in the family Nephilidae, establishing that this new species, on average, is the largest orb weaver known. Only the females are giants, however, with an average body length of 1.5 inches and a leg span of 4–5 inches; the males are tiny by comparison.

More than 41,000 spider species are known to science with about 400–500 new species identified each year. But for some well-known groups, including the giant golden orb weavers, the last valid described species dates back to the 19th century.

In response to the discovery of a seemingly unique *Nephila* specimen in 1978, Kuntner, Coddington, and colleagues launched several expeditions to South Africa to find this species. Their searches, however, were unsuccessful, suggesting that the specimen was a hybrid or perhaps an extinct species. Then, the finding of a second specimen from Madagascar in 2003 suggested that the spider found in 1978 was not a hybrid. As no additional specimens turned up among more than 2,500 samples from 37 museums, the species seemed extinct. When a South African colleague found a male and two females in Tembe Elephant Park a few years ago, it became clear that the specimens were indeed a valid new species.

The female of this new species, similar to other species in the Nephilidae family (such as *Nephila madagascariensis* pictured here), can have a leg span up to 5 inches wide.



### **NMNH Scientists Find Evidence that Plant Pollination by Insects Occurred Long Before Flowers Evolved**

Scientific evidence shows that almost all of the earliest angiosperms (flowering plants) were pollinated by insects. Whether such a relationship existed between insects and early gymnosperm species (non-flowering plants with exposed seeds, such as conifers) has been widely disputed. Smithsonian scientists, however, found evidence that gymnosperm plants shared an intricate pollination relationship with scorpionfly insects 62 million years before flowering plants appear in fossil records.



This discovery answers paleobotanists' questions about "strange" structures occurring in the reproductive cones of certain ancient plants," said Labandeira.



Conrad Labandeira, paleoentomologist at NMNH, and team members examined both the specialized features of scorpionfly mouthparts and the unique reproductive features of coexisting gymnosperm plants. The proboscis (elongated tubular mouthparts) of these

insects, which was up to 1.3 centimeters long, was either hairy or had ridges, and frequently had pads at the tip to suck up fluids, similar to the structure of modern moths and butterflies. The presumed gymnosperm hosts possessed deep funnel-like or tubular channels, also up to 1.3 centimeters long, containing nectar-like pollen drops..

The reproductive anatomy of the non-flowering plants show important modifications to attract insects, similar to modern flowering plants. However, the lineages of these plants and their scorpionfly pollinators became extinct approximately 105 million years ago, just as flowering plants and their newly evolved pollinators, such as butterflies, became established.

### **Smithsonian Environmental Research Center (SERC) Scientists Examine Plankton's Branch on the Tree Of Life**

SERC scientists are working on the Assembling the Tree of Life Initiative funded by the National Science Foundation. Researchers are using the latest tools in genetics to decipher the evolutionary relationships among dinoflagellates (a large group of organisms, most of which are marine plankton). These single-celled organisms are of global importance for many reasons: they are at the base of the food web that supports fisheries, they cause algal blooms, and they can produce toxins that threaten human health.



SERC's Tsvetan Bachvaroff analyzes massive amounts of DNA data to advance understanding of dinoflagellate evolution. His research is part of the Assembling the Tree of Life initiative.

Smithsonian scientists Wayne Coats and Tsvetan Bachvaroff, along with collaborators at other academic institutions, are using DNA analysis to advance understanding of dinoflagellate evolution. For the first time ever, they have discovered how to distinguish the genes of the parasitic dinoflagellate *Amoebophrya* from those of its host. *Amoebophrya* is important to the Assembling the Tree of Life investigations because it forms a branch at the base of the dinoflagellate lineage. Coats and Bachvaroff are laying the groundwork for future investigations of the evolutionary relationships in dinoflagellates and related taxa.

## SERC Scientists Predict Warn Climate Change May Drastically Alter Chesapeake Bay

The Chesapeake Bay is one of the largest and most productive estuaries in the world, yet dramatic changes are in store for it in coming decades if climate-change predictions hold true, say a team of SERC scientists and colleagues.

Using forecasts of atmospheric carbon dioxide production for the coming century, the scientists predict the water of the Bay will see rising levels of dissolved carbon dioxide and higher water temperatures. As a result, problems of low dissolved oxygen concentrations in the Chesapeake's water are expected to worsen and sea levels are anticipated to rise.

For fish and other organisms living in the Bay, the scientists predict:

- Populations of marine fish that favor warmer water and whose northern range ends near the Chesapeake (such as southern flounder, mullet, and tarpon) can be expected to increase.
- Many fish species that favor cold water (such as yellow perch, white perch, striped bass, and winter flounder) will disappear or become less abundant in the Chesapeake Bay.
- Fish susceptible to winter die-offs due to the seasonal cold weather of the Chesapeake may see a strengthening of their populations due to warmer water, with more juveniles surviving through the winter.
- Some fish parasites will likely benefit from warmer water, increasing their impact on fish and oysters in the Bay.
- Rising sea levels will submerge some of the Bay's wetlands, which many ecologically and economically important fish use as nursery areas and as foraging grounds.



In addition to effecting fish populations, an increase of carbon dioxide in the Chesapeake may raise the acidity of the Bay and reduce the ability of oysters, clams, mussels, and other animals to build calcium carbonate shells.

With warming temperatures, the species that make up the food web of the Chesapeake Bay will be impacted differently, likely disrupting the normal interactions between predator and prey species. Hypoxia, or a lack of oxygen in the water, will be another prevailing characteristic of warmer Bay water with expected negative effects. At warmer temperatures microbes will consume oxygen at a higher rate and less oxygen can dissolve in warm water. At the same time fish and perhaps other animals will require more oxygen in warmer water.

## Smithsonian Tropical Research Institute (STRI) Researchers Use Camera Traps and Radio Collars to Reveal Hoarding Strategies of the Agouti

In a series of ongoing experiments on Barro Colorado Island in the Panama Canal, STRI researchers are using camera traps, radio collars, and palm nuts with attached tracking transmitters to take a closer look at the nut-hoarding strategies of the agouti (a large rodent from Central and South American rain forests).

Rabbit-sized with squirrel-like habits, the agouti is a hoarder and a robber. When not collecting fallen nuts and burying them in shallow holes, it is adept at finding, stealing, and re-hiding nuts buried by its agouti neighbors. A single nut might be hidden and stolen multiple times. The agouti's method of seed dispersal and caching is critically important for tropical trees, as it gives seeds a much better chance for germination.

Hoarding seeds is also important for the agouti. In certain seasons food is scarce in the tropical jungle. Just as squirrels in North America hide acorns to survive snowy winters, agoutis hide nuts in the tropics to survive periods when little food is available.

The agouti's method of seed dispersal and caching is critically important for tropical trees, giving seeds a much better chance for germination.



The researchers found that where less food is available, agoutis spread their seed caches more widely, making it harder for pilferers to find the nuts they hide. "To hide nuts further away from the tree where they are found requires more energy, yet an animal benefits when fewer of their caches are found by pilferers," says Roland Kays, a STRI mammalogist. "In lean areas competitors increase their foraging and the hoarders are left with no other choice but to spend more time in hiding seeds or lose them to thieves."

Sequencing also plays a role in seed dispersal the researchers found. In taking seeds from a tray laid on the ground, the agoutis hid the seeds they first removed closer to the tray than the seeds they took later on. The researchers also learned that larger seeds are hidden with more care than smaller seeds. "In terms of energy value, a larger seed is more valuable and worth the extra effort to hide it," Kays said.

"It is interesting that a rodent can be doing this. It is ingrained in the calculations of the daily life of an agouti to make these optimal decisions."



## STRI Researchers Find that Tree Frog Embryos Can Evaluate Different Features of Vibrations

Researchers from STRI and Boston University have been taking a closer look at the vibrations that red-eyed tree frog embryos use as cues to trigger early hatching. The researchers—Karen Warkentin of both STRI and Boston University and Michael Caldwell and J. Gregory McDaniel of Boston University—embedded tiny recording devices into red-eyed tree frog egg clutches and recorded the low-frequency vibrations caused by snakes as they ate the eggs and also measured the vibrations caused by rain storms. They played back these vibrations to egg clutches in a laboratory and found that some of the embryos hatched in response to the snake-generated vibrations and not to the rain vibrations.

This experiment showed that the embryos were responding to and could differentiate between snake vibrations and rainstorm vibrations. The embryos didn't need chemical or visual cues from snakes.

What puzzled the researchers was that the low-frequency vibrations triggering the embryo hatchings were in some ways very similar to vibrations caused by many benign forest stimuli—such as rainfall, wind, or non-predatory animals. “Hatching early in response to benign stimuli would be a serious error,” Warkentin explained, “since premature hatchlings are vulnerable to predators in the pond. We reasoned that if a defense—such as hatching early—is costly for prey, then mechanisms should be in place to avoid false alarms, just as mechanisms exist to recognize and defend against predators.”



A snake can eat a clutch of red-eyed tree frog eggs in five minutes—but some of the frog embryos can sense the vibrations of the snake's eating and hatch prematurely.



In recent laboratory work the scientists improved their understanding of how these false-alarm mechanisms work in regard to rainfall. The low-frequency vibrations generated by rainstorms are accompanied by two elements that snake-feeding vibrations do not have: high-frequency vibrations and an initial buildup of intensity. When these two features were removed from rainfall recordings and played back to embryos in the lab, many of the embryos hatched.

# East Meets West

In October 2009 the Smithsonian American Art Museum, with the cooperation of Freer and Sackler Galleries, the Asian Pacific American Program, and the Archives of American Art, organized *East-West Interchanges in American Art*, a symposium sponsored by the Terra Foundation for American Art. The symposium drew the participation of Smithsonian, university and international scholars to examine the connections and mutual influences of American and Asian art. They found that Smithsonian collections revealed far richer interactions and inter-cultural creativity than heretofore appreciated; and that the interaction is not only historic; it also continues in contemporary form. A forthcoming book as well as other activities across the Smithsonian will help re-write missing chapters of American and Asian art history.



## ORIENTALISM

### 1. *Harmony in Blue and Gold* "Peacock Room,"

1876-77 home of Frederick Leyland,  
1904 home of Charles Lang Freer  
James McNeill Whistler (1834-  
1903), after Thomas Jekyll  
FREER GALLERY OF ART

1



## SOCIAL COMMENTARY

### 2. *The Chinese in New York—* *Scene in a Baxter Street Club* *House*

1874, Harper's Weekly  
Wood engraving on paper  
Winslow Homer (1836-1910)  
SMITHSONIAN AMERICAN  
ART MUSEUM

## AMERICAN PAINTER FOR THE LOUISIANA PURCHASE EXPOSITION

### 3. *The Empress Dowager,* *Tze His, of China* 1903, Oil on canvas Katharine Augusta Carl (1862-1938) SMITHSONIAN AMERICAN ART MUSEUM

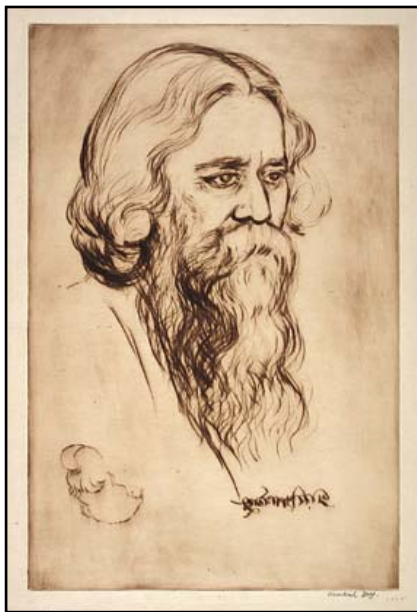
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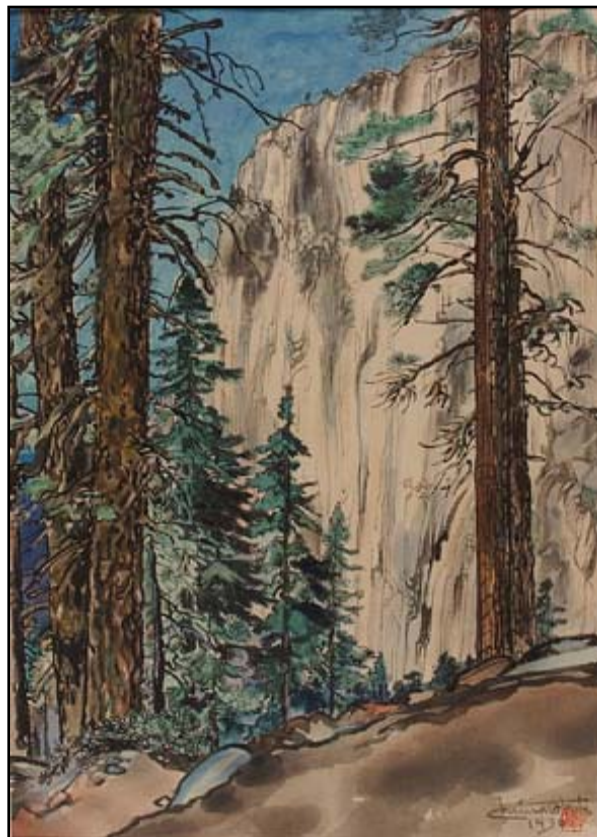
AMERICAN PAINTER LEARNS  
JAPANESE TECHNIQUE  
4. *The Sauce-Pan Shop*  
1908, Color woodcut on paper  
Helen Hyde (1868-1919)  
SMITHSONIAN AMERICAN  
ART MUSEUM

4



5

INDIAN PAINTER LEARNS  
ETCHING TECHNIQUE IN CHICAGO  
5. *Sir Rabindranath Tagore*  
Circa 1916, Drypoint  
Mukul Dey, born Sridharkhola  
(1895-1989)  
SMITHSONIAN AMERICAN ART  
MUSEUM



6

IMMIGRANT APPLIES JAPANESE STYLE TO  
REPRESENTATION OF THE AMERICAN WEST  
6. *Eagle Peak Trail*  
1930, Color woodcut on paper  
Chiura Obata born Okayama ken (1862,  
Japan-1938, Berkeley, California)  
SMITHSONIAN AMERICAN ART MUSEUM



JAPANESE IMMIGRANT PAINTER DEPICTS  
INTERNMENT IN POST-IMPRESSIONIST STYLE  
*7. Arrival in Camp Jerome*  
Circa 1943, Oil on canvas  
Henry Sugimoto born Yuzuru Sugimoto  
(1900, Japan-1990, New York)  
NATIONAL MUSEUM OF AMERICAN  
HISTORY

7



JAPANESE IMMIGRANT PAINTER  
CONFLATES STYLES TO DEPICT  
CONTRADICTORY THEMES OF INTERNEE'S  
AMERICAN EXPERIENCE  
*8. Thinking of Loved One*  
Circa 1944, Oil on canvas  
Henry Sugimoto born Yuzuru Sugimoto  
(1900, Japan-1990, New York)  
NATIONAL MUSEUM OF AMERICAN  
HISTORY

8



IMMIGRANT FOLK ART DEPICTS EPISODE IN  
JOINED ASIAN AND AMERICAN EXPERIENCE  
9. Hmong *paj ntaub dab neej* flower cloth  
Circa 1990, Cloth embroidery  
My Yia Vang (1958, Laos-migrated 1980 to  
Wisconsin)  
NATIONAL MUSEUM OF AMERICAN HISTORY

9



CONTEMPORARY COMMENTARY- GLOBAL ARTIST  
10. *Electronic Super Highway*  
1995, Multimedia  
Nam June Paik (1932, Seoul, Korea-2006, Miami, Florida)  
SMITHSONIAN AMERICAN ART MUSEUM

10



11

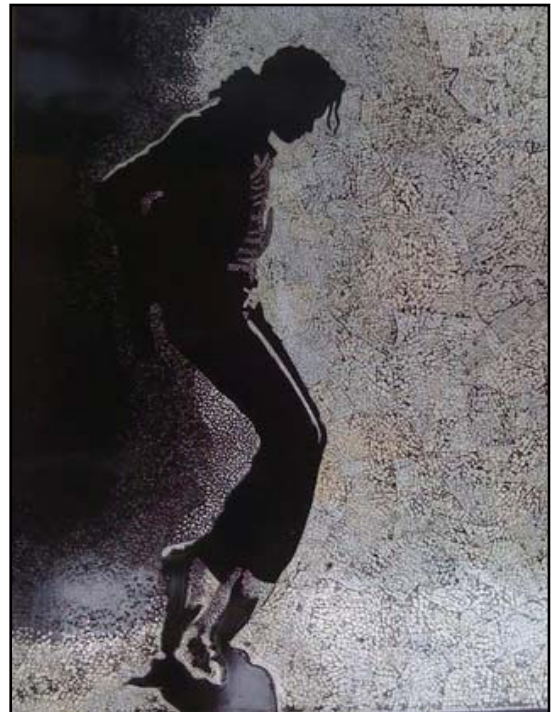
DYNASTIC TRADITION

11. Lacquer wood plate with mother-of-pearl inlay, 13-14<sup>th</sup> century  
Southern Song to Yuan Dynasty  
FREER GALLERY OF ART



12

CONTEMPORARY VIETNAMESE  
12. *The Buffalo Boy*  
2007, Lacquer son mai, eggshells and acrylic,  
Le Ngoc Thanh & Le Duc Hai (Twins) (1975,  
Vietnam-)  
EDEN CENTER-GALERIE BRIGITTE/  
SITES -ASIAN PACIFIC AMERICAN  
PROGRAM VENUE



13

CONTEMPORARY VIETNAMESE-AMERICAN  
13. *Moonwalk on Eggshell: Michael Jackson*  
2009, Lacquer son mai, eggshells and acrylic  
Quan Le (1958, Vietnam- ) & Brigitte Le  
(1962, Vietnam-1975,migrated to Virginia)  
EDEN CENTER-GALERIE BRIGITTE/  
SITES -ASIAN PACIFIC AMERICAN  
PROGRAM VENUE



14

CONNECTING CULTURES

14. *Tibetan Culture in Washington*

2000, Watercolor on canvas *thangka*

Sangei Yeshi (?)

Gift of the Dalai Lama

CENTER FOR FOLKLIFE AND CULTURAL HERITAGE