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Natural Science Collections: America's Irreplaceable Resource

MICHAEL A. MARES

The nation's natural science collections form an irreplaceable record of scientific discovery across time and space and are a resource that contributes vital information daily across the spectrum of scientific disciplines. The utility of specimens extends far beyond what was originally expected. The brain structure of dinosaurs can be examined through CT scans. DNA from tissue, microbe, or standard study specimens infuses genetic, evolutionary, and public health research. Meteorites help clarify our understanding of astrophysics. Biological, archeological, paleontological, and mineral collections are critically important in studies of global climate change and conservation. Collections of vertebrates, invertebrates, molds, and plants are routinely used in forensic investigations of murder, wildlife smuggling, food contamination, and public health. Agricultural research is tied to collections of insects, plants, bacteria, and molds in efforts to combat crop plant diseases and increase productivity. Even national security issues require good collection information to understand the origin and spread of human and plant pathogens and pests that may be used in biological terrorism.

Despite these facts, the nation's natural science collections have suffered decades of neglect and are in imminent danger of irreversible damage. Incongruously, their value and importance are constantly growing while they face deterioration, neglect, and catastrophic loss because of substandard facilities, a lack of curators and collection support personnel, and declining budgets.

Examples of the sorry state of the nation's collections are legion:

- A university collection of 75,000 birds and mammals was flooded with four feet of hot water. Thousands of specimens collected over a half-century were damaged. They are now stored in a building off campus that offers little protection from severe storms, pests, and other threats.
- A building at a southeastern university was condemned for use by a monkey colony because it was deemed unsafe for the primates. Major invertebrate, reptile, and amphibian collections were then moved into the building. This university houses its archeology collections—an invaluable record of the state's prehistory—under a building crawl space where ceilings are less than four feet high, lights are few, and climate controls nonexistent.
- One of the largest fossil collections in the country at a midwestern university museum was housed in an abandoned ex-military building. Part of the roof had collapsed, and a flock of hundreds of birds nested in the building, flying over the collection and covering the fossils with droppings, thus speeding the disintegration of the paper documents associated with the specimens. After a report was filed on the poor state of this remarkable collection, it was moved into an abandoned school building, eventually ending up in the basement of a campus building. Its situation has improved, but it now has fewer active curators than before.
- In the western United States, in the heart of an earthquake zone, a major university's extensive fossil collection is stored in a basement. Visitors are informed that should an earthquake occur, they will most likely be crushed under tons of cases and fossils that are stacked high and unsecured to solid anchor points. Staff members working in the collection are at high risk.
- At a leading Ivy League university, a case of preserved bat skins was completely eaten by dermestid beetles. Only the cotton, wire, and tags remained. This was one of the early collections in the country, and the specimens had great historical value.

Because of a lack of funding and the scarcity of specialized collections personnel, most collections have not become part of the electronic universe that has changed the face of society, and vital data are not electronically available for use by scientists. Even basic questions such as how many specimens exist cannot be answered with precision. Digitization of specimen and ancillary data and new electronic research tools are beginning to be developed, but most collections have yet to become part of the enterprise because of the dearth of personnel and infrastructure. Even proofing of digitized data and verifying identifications suffer from lack of human resources. National leadership on the nation's collection heritage has been lacking. The National Science Foundation and the Institute of Museum and Library Services have supported natural science collections to a degree, and they are to be lauded for that effort. But the budgets of both agencies to support collections are paltry compared with the scale of what is needed to recover and modernize the nation's collections and make them available for researchers worldwide. The value of America's natural science collections is incalculable, and the specimens themselves irreplaceable. It is impossible to replicate the data that have been amassed over centuries. Yet for many, if not most, of the nation's collections, the data remain as difficult to access as if they were still part of the Victorian era. Their physical plants are dismal.

Let us consider how invaluable the national collection resource is when applied to current scientific questions:

- Should a new life form be found within a Martian meteorite or on Mars, it will be compared with mineral, geological, genomic, and biological specimens in collections for verification.
- When birds bring down an airliner, biological and tissue collections are used to identify the species so that specific modifications can be made (in engine design or runway placement, e.g.) to keep the species away from danger areas, thus improving air safety.
- When the theory that a meteor impact caused the extinction of the dinosaurs was developed, it was an almost forgotten collection of oceanic core drillings taken from the zone of impact many years earlier that was used to prove the fact of the impact, as well as its age.
- The cause of the sudden extinction of North America's megafauna has been debated for decades, with many supporting the hypothesis of overhunting by humans, but a recent suggestion that a comet caused the extinction is supported by specimens related to archeological collections of Clovis sites up to 10,000 years old.
- Bones of museum specimens are an ideal source of viruses to study viral evolution over time. Sin Nombre and other hantavirus research uses tissues

and specimens from the nation's museum collections, as do studies dealing with emerging deadly viruses.

- Ideas that the geological field of Earth is changing over time and perhaps moving toward a magnetic polar shift are supported by archeological collections of pots that were cast more than a thousand years ago, capturing the prevailing magnetic pole of that day within the pottery itself.
- DNA is now routinely sequenced from dried specimens prepared centuries ago so that even extinct species can be compared with living relatives to clarify the relationships of species over time. Attempts are now under way to clone genetic material from extinct species such as the woolly mammoth or the Thylacine (the marsupial "tiger"). In both cases, genetic material is being obtained from museum specimens.

The nation's remarkable collections of perhaps a half billion objects and specimens provide the scientific underpinnings for understanding the world's living and nonliving systems. They contain species that are now extinct as well as species moving toward extinction. In the future, all we will know of such organisms will have to be obtained from specimens in collections.

As cascading extinctions develop and the race to discover new species quickens, global biodiversity will be understood only through comparisons with the almost two million type specimens that have been gathered over centuries. Absent this database, new species will

remain undiscovered and unnamed, disappearing before conservationists know they existed. Without collections, taxonomy ceases, and without taxonomy, scientific research is hindered. We have discovered perhaps only 10 percent of Earth's species, and that unknown portion of life on the planet can be named and studied only through the use of collections.

Immediate action at the federal and state levels is required if the nation's thousands of natural science collections are to be preserved. These specimens cannot be replicated and remain unique markers of life on Earth at specific points in time and space. Collections are located in every state, and a move to preserve this irreplaceable resource would represent bold action that would have an immediate, significant, and positive effect on the nation's economy, as well as its scientific future. Quick action will bring this vital resource into the new century to better serve the needs of the nation and the world in the challenging years to come. The only certainty regarding natural science collections is that their importance will grow daily, and they will continue to be used in ways that we cannot imagine today. That has been the history of what constitutes one of our society's most treasured resources.

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