

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

STUDENTS LEARN HOW THE GENOGRAPHIC PROJECT, BIOARCHAEOLOGY, AND EXPERIMENTAL ARCHAEOLOGY TEACH US ABOUT EARLY NATIVE PEOPLES.



### STUDYING ANCIENT POPULATIONS THROUGH MODERN GENETICS

**GENETICS** is a branch of science. It investigates what we inherit from our parents (like brown eyes or wavy hair), how we inherit these traits (through our genes), and the variation or differences among all living things. Scientists study genetics to understand how genes function in a healthy body, how genes contribute to disease, and what genes can tell us about the history of all living things. When genetics is applied to human history, it studies populations (or groups of humans) not individual people.

**GENEALOGY** is a branch of history. It investigates a person's family history by researching documents (like birth certificates) and family stories that have been handed down for generations. Since the 1990s, genealogical research has expanded to include genetic testing, which can suggest a genetic relationship between two people (or groups of people) even when no documents exist to support that conclusion. Genealogy focuses on individuals and families (not whole populations).

What is the *Human Genome Project*? This is **GENETIC** research – a project which has mapped about 92% of the 30,000 base pairs in human DNA. This information is used in studying the variation within human populations and in searching for cures for genetic diseases.

What is the *Genographic Project*? This is **GENETIC** research funded by the National Geographic Society to track migration patterns of humans out of Africa. This project is not-for-profit. No medical research is included. It is focused only on learning about migration in human history.

What is *FamilySearch*? This is **GENEALOGICAL** research – a vast website which helps individuals track their family histories at no cost. You can input a person's first and last name, the state where they lived, and the dates they lived. The website shows you any documents relating to that person. For example, my grandmother's name brought up the handwritten 1945 census for Dade County, Florida. In the census listing, my grandmother was 34, and my mother was only two-years-old.

What is *Family Tree DNA*? This is just one of many **GENEALOGICAL** companies that uses genetics as a tool to identify recent ancestors for clients. For a fee, they can identify the mutations in your Y-chromosome (if you're male) or on your mitochondrial DNA (if you're female). They advertise specific services to adoptees hoping to find birth parents, to those searching for Jewish, African American, or Native American ancestry, and to people just looking to learn more about their family tree. These services can provide clues to ancestry, but they cannot prove genetic relationships.

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### GENETICS AND THE STORY OF HUMAN MIGRATION

The human genome includes all of the genetic information needed to create a human being. This information is stored in the DNA in our cells. Scientists have discovered about 25,000 distinct genes (which are only a small part of the total human genome). These genes provide instructions for making proteins - the building blocks of human bodies. The rest of our DNA is called “junk DNA” because it does not code for any specific protein. This junk DNA is still copied along with the useful parts of our DNA and is included in everyone’s genetic code.

Every so often, tiny errors occur when genes are being copied. If these errors – called mutations – occur in the somatic (body) cells, they are not passed on to the next generation. If instead, the mutations occur in the gametes (egg and sperm cells), the tiny changes can be passed on.

Some mutations are harmful. In these cases, due to natural selection, the individual may not survive to pass the mutation on to future generations. A few mutations are beneficial. In these cases, the individual may be more successful and have more chances to pass the mutation on to the next generation.

Most mutations occur in the junk DNA. As a result, they don’t affect the organism’s ability to survive at all. Natural selection does not act on these mutations, so they get passed on like nothing ever happened. Scientists who are studying human migration patterns focus on our “junk DNA.” Two kinds of mutations are tracked: STRs (short repeated segments) and SNPs (changes in a single nucleotide).

### A LOOK AT STRS (REPEATS)

An STR occurs when a short section of DNA gets repeated. They’re often studied on the Y-chromosome. One section of the Y-chromosome is called DYS-454. This section of chromosome contains the DNA sequence “AAAT.” Roughly 96% of men have 11 repeats of the section “AAAT.” 3% have 10 repeats, and 2% have 12 repeats.

For example, 96% of men have:

AAAT – AAAT – AAAT – AAAT – AAAT – AAAT – AAAT – AAAT – AAAT – AAAT – AAAT  
1        2        3        4        5        6        7        8        9        10       11

What exactly does this mean? When a mutation occurs, it can cause one repeat to be added OR one repeat to be deleted. If you have 12 repeats, you are more closely related to a man with 11 repeats than you are to a man with 10 repeats. This can be used in paternity testing (to see how closely a baby is related to a potential father). Police also use STRs to create a “genetic fingerprint” for identifying crime suspects.

# CHAPTER NINE

## ARCHAEOLOGY-BEYOND EXCAVATION

Some genealogical tests check 67 different STRs on the Y-chromosome. The more similar you are to another man across the 67 repeats, the more closely you are related. Y-STR studies are only available for men because only males have Y-chromosomes. Y-STRs (as well as repeats on autosomal [non-sex] chromosomes) are often used for genealogical research, matching relatives within the last 200 years.

### A LOOK AT SNPS (SINGLE CHANGES)

An SNP is a change that occurs at a single nucleotide (one base pair). So, one C might become an A. Or one T becomes a C. It's just one small change. These changes are often tracked when studying mitochondrial DNA (mtDNA).

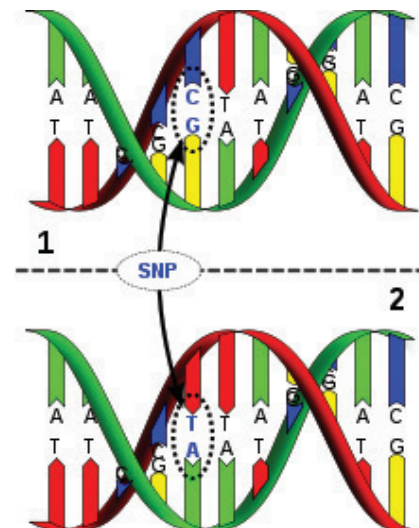
What is mitochondrial DNA? Mitochondria are the tiny energy-making organelles inside our cells. They exist outside a cell's nucleus and have their own DNA. When an egg and sperm join, mitochondrial DNA is contributed from the egg, but not from the sperm. So, mtDNA tracks mutations through your female ancestors. Y-chromosome SNPs track mutations through your male ancestors.

### HOW CAN MUTATIONS TRACK HUMAN MIGRATION?

Mutations (mistakes in copying DNA) do not happen very often. But they do seem to occur at a constant rate. Some STR mutations occur once every 500 generations. This means that two mutations would occur after 1,000 generations. Three mutations would occur after 1,500 generations, and so on. How long is a generation? A generation is the length of time between the birth of a parent and the birth of her child. Twenty-five years is sometimes used as an estimate.

STRs and SNPs on the X and Y chromosomes are used for tracking changes across ancient populations of humans (more than 5,000 years ago). This information shows that all humans originated in Africa and started moving out into the rest of the world about 65,000 years ago.

Africans have more genetic variation than any other population on the planet. When groups of humans left Africa, their cells only carried a small part of the genetic variation of the entire African population. Later mutations in the genome of the migrating group made it even more distinct from the parent population. By comparing genetic differences among populations, geneticists can show which groups left Africa earlier or later, and where they travelled afterwards. You can go to the Genographic Project website at <https://genographic.nationalgeographic.com/genographic/lan/en/atlas.html> to see an interactive map showing human migration across the globe.



*This illustration shows an SNP, in which a single base pair has changed. What used to be a cytosine-guanine pair, is now a thymine-adenine pair.*

*Illustration by Wikipedia*

# CHAPTER NINE

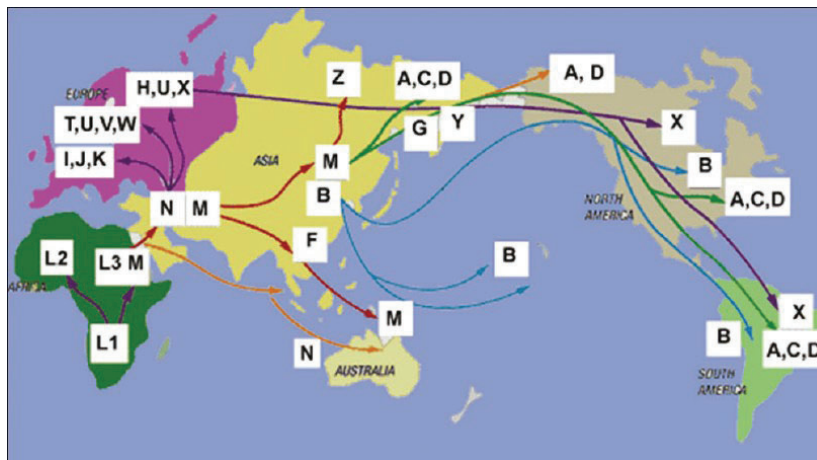
## ARCHAEOLOGY-BEYOND EXCAVATION

By 30,000 BCE, humans had travelled into India, Asia, Australia, and Europe. By 25,000 BCE, people were crossing the Bering Land Bridge between Asia and North America. By 15,000 BCE, humans had populated North and South America. These dates can be established using traditional archaeology, but the Genographic Project provides information about which path humans followed to get to these places.

**REMINDER:** When discussing the distant past, scientists generally use BCE (Before the Common Era) instead of BC (Before Christ). BCE and BC mean exactly the same thing. Instead of AD, scientists use CE (Common Era). So, an event that occurred 15,000 years BCE (or BC) could also be described as occurring at 17,000 years ago. [15,000 + roughly 2,000 years = 17,000 years ago]

### WHAT IS A HAPLOGROUP?

When geneticists began tracking the movements of early humans across the globe, they needed to name each group that possessed a new set of mutations. These major groups are called Haplogroups, and are described by a letter. The original African haplogroup (when tracing the female line) is called “L”. “M” was the first group to leave Africa. Native Americans are often included in the following haplogroups: A, B, C, D, X. Having any one of these mutations does not prove Native American ancestry, as they can be found in other populations around the world. However, having many of them is a good indicator of Native American ancestry.



*This is a map showing where different haplogroups are common.*

*Native Americans often (though not always) have the following genetic markers: A, B, C, D, X.*

*Illustration by Wikipedia*

This lettering system is for mutations found on mtDNA. There is a different naming system for mutations on the Y-chromosome. Geneticists are also studying repeats on autosomal (non-sex) chromosomes. Chromosome Number-9 has a repeating section that is common in Native American populations. Scientists have compared this STR in populations of Native Americans, Asians, Europeans, and people living in Berengia (the area where the Bering Land Bridge connected Asia and North America during the last Ice Age).

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

The 9-allele mutation is common in all Native American populations. It is NOT found in Asian or European populations. It IS found in the populations living in Berengia. This shows that Native American peoples all came from the same place – Berengia. They probably crossed the Bering Land Bridge in three separate migrations over thousands of years. But they didn't start their migration from Europe or Australia or the Orient. They'd been living in Berengia for quite some time.

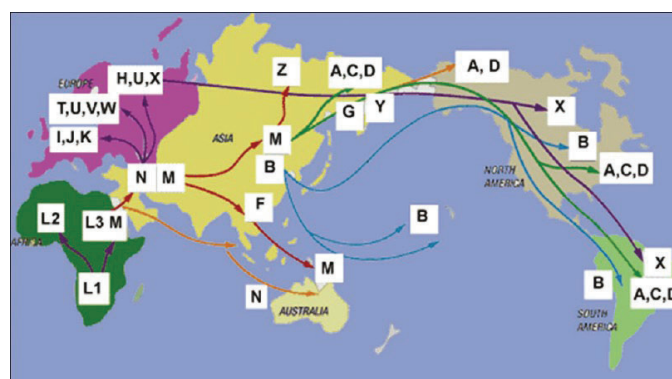
Genealogy companies will, for a price, check the DNA of a person wishing to clarify his ancestry (whether it is Native American, African, or anything else). If a person's haplotype (specific section of a haplogroup) includes several of these mutations (A, B, C, D, X, and the 9-allele repeat), they are considered to be genetically Native American. Currently, this information is not recognized by the US government or by tribal leaders as proof that a person is Native American.

NOTE: Genetic studies are concerned with populations – groups of people. Some individuals in a Native American population might have A, B, and X mutations, while others have D and the 9-allele repeat. It's the population as a whole that includes all of these mutations. What does this mean? It means that there is NO way to genetically identify a person's race. There's no genetic code for a Native American or an African American or a Mexican American. There are just genetic tags that suggest ancestry. None of these mutations has any affect on a person's appearance or on their mental or physical qualities.

### ACTIVITY – TAKE A LOOK AT A HAPLOGROUP MAP:

**INSTRUCTIONS:** Use the Haplogroup Map and the regional color lists below to answer the following questions.

- Pink:** Northern Europe, Western Europe
- Dark Green:** Northwest Africa, Northeast Africa, Southern Africa
- Yellow:** Middle East, Eastern Asia, Siberia, Berengia, Australia
- Tan:** Alaska, Eastern North America
- Light Green:** Western South America, Eastern South America



*Haplogroup Map, illustration by Wikipedia*

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### ACTIVITY – TAKE A LOOK AT A HAPLOGROUP MAP *continued*:

1) A man learns that he has an “A” marker. Which geographic areas are linked with this marker?

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2) A young woman discovers that she has a “U” genetic marker. Which geographic areas are linked with the marker U?

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3) A grandfather working on his family tree learns that he possesses a “C” marker. Which geographic areas are linked with the marker C?

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4) A woman participating in the Genographic Project learns that she possesses an “N” marker. Which geographic areas are linked with the marker N?

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5) A man who was adopted is trying to learn more about his birth parents. He has an “L” marker. Which geographic areas are linked with the marker L?

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6) Three middle school students volunteer to participate in a local genealogy project. Daniel has the genetic marker D. Marissa has M. And Jeff has J. Which student belongs to the lineage that is most similar to the original African population? Which is the most different?

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# CHAPTER NINE

## ARCHAEOLOGY-BEYOND EXCAVATION

### STUDYING ANCIENT POPULATIONS THROUGH ISOTOPES, CAVITIES, AND SKELETAL STRESS

The study of human genes is only one method of looking inside human beings for clues to the past. Human skeletons can also be studied to look for signs left by the foods they ate, the diseases they battled, and the kinds of physical stress they endured. To research these topics, archaeologists need access to the skeletons of early Native Americans. Most of the skeletal remains of native people are protected by a piece of legislation called NAGPRA.

What is NAGPRA? Today, most archaeologists study artifacts found in **middens**, not in **burial mounds**. And they rarely study skeletal remains at all. Why? The Native American Graves Protection and Repatriation Act (NAGPRA) is a powerful piece of legislation that protects Native American graves, including skeletons and the artifacts associated with them. (“Repatriation” means to return someone to the place they came from.) Throughout American history, Native American graves have been pillaged for “treasures.” These Native Americans were not buried in formal graveyards, so their gravesites were not protected by the laws that protect other burials.

Native American burial practices are closely intertwined with religious beliefs. The freedom to practice religion is protected by the First Amendment of the Constitution. NAGPRA regulations seek to protect both the integrity of the native graves and the religious freedoms of past and present Native Americans.

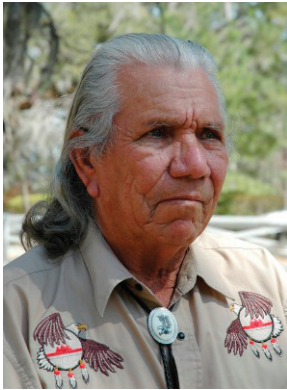
Since 1990, when this legislation came about, the skeletons of 32,000 Native Americans have been repatriated (returned to the tribe they were most closely related to). These skeletons had been housed in museums and federal facilities for years. In addition to the skeletal remains, 793,500 burial or sacred artifacts have been returned to native peoples.

**How does NAGPRA affect archaeology?** It gives modern native groups the power to protect any human remains excavated on government-owned lands. If a modern native group can prove kinship with the deceased, they have the right to approve or deny any tests the archaeologists wish to perform. They may also demand immediate reburial of their ancestor and associated grave goods. Many native groups believe it is disrespectful to unearth the dead or to perform invasive tests on them. As a result, archaeologists are rarely permitted to study skeletal remains.

The Timucua and almost all of Florida’s historic Indians disappeared by the 1760s. They have no descendants who actually consider themselves “Timucua.” Because no one can claim a genetic connection with these early Floridians, their remains are considered “culturally unaffiliated.” Archaeologists can request to study the skeletal remains of these “culturally unaffiliated” native people by contacting the museums that curate them.

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION



Chief Gilmer Bennett of the Apalachee, 2009.  
Photo by Wikipedia.

Why can't the Seminole claim these early remains? The Seminole's ancestors migrated into Florida from Georgia and other areas in the early 1700s. As a result, they and the Timucua are from completely different cultural groups.

Are any of Florida's historic native peoples affiliated with a modern group? Just one: the Apalachee. In 1704, the Spanish withdrew from Apalachee province (the Tallahassee area) after attacks and slave raids by the British and their native allies. To regain Spanish protection, many of the remaining Apalachee moved towards St. Augustine. There, they blended with other refugee groups, including the Timucua.

However, one group of 800 native peoples – mostly Apalachee – headed west instead. First, they settled in Mobile, Alabama, where the French described them as being “good Catholics.” On September 6, 1704, records show that an Apalachee was baptized there, leaving a clear historical paper trail of the Apalachee exodus. In 1763, eighty Apalachee people moved on and settled in Rapides Parrish in central Louisiana. Catholic Church records describe priests visiting an Apalachee village in Rapides in 1769, a village with a large wooden cross built adjacent to their hilltop home. About 300 Apalachee live there today. They are known as the Talimali Band of the Apalachee and are led by Chief Gilmer Bennett.

### WHAT IS BIOARCHAEOLOGY?

Bioarchaeology is the study of ancient human remains. Through studying these skeletons, archaeologists hope to learn how humans adapted to stresses in their environment. What kinds of stress leave marks on a person's skeleton? Malnutrition (specifically lack of iron) can cause rippled, spongy-looking marks on the skull. If a person regularly carries heavy loads (especially during adolescence), his bones thicken to handle the weight. When a person is subject to an extremely heavy workload, the stresses actually degrade his joints. This is called osteoarthritis. Scientists can even determine whether a person ate mostly fish or mostly corn by looking at the levels of carbon and nitrogen isotopes in their bones.



Florida and Georgia map showing three Contact Period Cultures.

One bioarchaeology study analyzed the skeletal remains of Timucua, Apalachee, and Guale people (see map to right). Some of the skeletons represented people living before the Spanish set up missions. Others represent people who actually lived in mission villages. Archaeologists were looking for evidence of cultural changes introduced by the Spanish missions.



# CHAPTER NINE

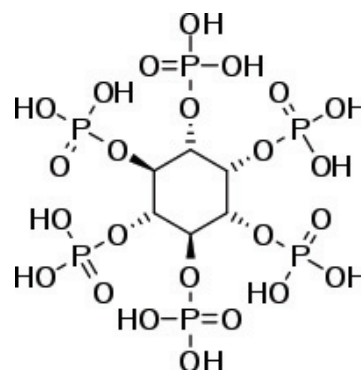
## ARCHAEOLOGY - BEYOND EXCAVATION

**Let's talk about iron.** Every multivitamin includes iron. It is the building block for red blood cells which carry oxygen throughout our bodies. Lack of iron, a condition called anemia, causes fatigue, shortness of breath, inability to focus, and poor general health. The body responds to chronic (long-term) anemia by producing more red blood cells (RBCs). These cells are normally manufactured in the long bones. In cases of chronic anemia, the body induces skull bones (both the flat bones across the top and the eye orbits) to go into RBC production. This causes the skull and orbits to show the same porous ripped appearance as bone marrow. Researchers recorded the percentages of skulls which showed these signs of iron deficiency. The results for juveniles (under 16) showed the clearest trends. Only 6.1% of the kids living just before the mission period experienced chronic iron deficiency. After the establishment of missions, 73.7% of the kids living well showed iron deficiency. What could cause such a huge decrease in dietary iron? In a word: corn.

Corn contains the chemical phytate, which bonds to iron, preventing its absorption by the small intestine. As a result, iron deficiency often suggests high rates of corn consumption. Why were the Timucua suddenly eating so much corn? Missions were established in villages that were growing enough corn to supply the priests with food. As St. Augustine demanded more and more corn from each village, corn production AND corn consumption increased. Interestingly, when corn is eaten together with fish, iron absorption increases by up to 50%. Scientists still haven't figured out why, but this "meat effect" is actually prescribed to improve iron deficiencies in communities world-wide.

**Biological Note:** Phytate is a natural chemical that grain plants create to store phosphorus. Neither humans nor pigs can digest this chemical because we lack the necessary digestive enzyme. Cows can digest phytate because the microbes living in their many-chambered stomachs produce the necessary enzyme.

**Genetically Modified Crops:** Researchers at the University of Colorado have engineered a new strain of corn that has 95% less phytate than normal. A study of Guatemalan men showed that iron absorption increased by 50% when eating low-phytate corn. This corn has tremendous positive potential for the environment too. Pigs and chickens are fed diets of corn, but they can only digest 15% of the phosphorus in their feed because it's all locked up in non-digestible phytate. What isn't digested comes out the other end as waste. This produces whole lagoons of pig and chicken poop full of phosphorus, a potent fertilizer. In the environment, excess fertilizer can cause toxic algae blooms in lakes. So, low-phytate corn, by decreasing the fertilizer-content of farm waste, protects the environment. Over the past ten years, low-phytate varieties of rice, barley, and soybean have been engineered, in addition to corn.



*A phytate molecule. All of the P's are chemically bound phosphorous atoms.*

*Image by Wikipedia*

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

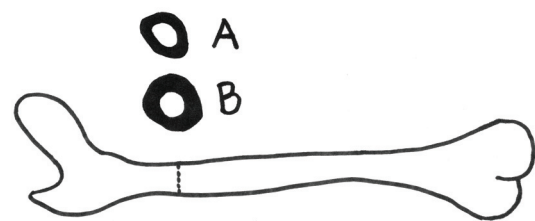
**Let's talk cavities.** The teeth of these Florida and Georgia peoples were also assessed for cavities. Because corn is a carbohydrate (a complex sugar), it contributes to cavities. Native people living before corn agriculture had cavities in only 1.2% of their teeth. Those living after the beginning of corn agriculture (both before and during the mission period) showed an increase in cavities. Now, 7.6 to 9.6% of teeth were afflicted with cavities. During the late mission period, when maize agriculture had really stepped up, 19.6% (or one in five) teeth had cavities. That's pretty convincing archaeological evidence that matches the historical descriptions of increased corn agriculture.

**Let's talk skeletal stress.** Repetitive tasks, which cause long-term wear and tear on the joints, can lead to bone degradation – or osteoarthritis. Two interesting trends were discovered when archaeologists studied the joints of these early peoples. First, osteoarthritis decreased from the early prehistoric period (0-1000 CE) to the late prehistoric period (1000-1550 CE). Was there something about the switch to growing corn that was easier on the back? Growing and processing corn is hard work. But harvesting and processing wild plants may have been even harder. The unit on Wild Plants details the effort required to process plants like cattail, acorns, and coontie. Compared to that, corn may have called for less pounding and grinding.

The second trend was a radical increase in osteoarthritis for the late mission period (1680-1700 CE). During this time, St. Augustine set up labor draft. Each native village was required to send men to St. Augustine to work on fort construction and other projects (they usually weren't paid for their labor either). The men had to walk all the way there while carrying all of the food they would need. The increase in osteoarthritis provides archaeological evidence of how this labor draft impacted mission Indians. The percentages of osteoarthritis found in each time period are Early Prehistoric: 26%, Late Prehistoric: 16.4%, and Late Mission: 68.3%.

**Let's talk adaptation.** The human body doesn't just respond to stress with disease. It can also adapt, making the person stronger and more able to handle the stress. How? Bones actually get thicker so that they can handle greater stresses. In this illustration, you can see the thickness of the femur (upper leg bone) measured at two different points. Note the thicker bones in mission-period Indians.

**Let's talk isotopes.** Not the radioactive kind this time. Carbon and nitrogen both have stable isotopes, each with an extra neutron. This extra neutron makes each atom a bit heavier. The slight weight difference means that Carbon-13 is absorbed at a different rate during photosynthesis than C-12. For every 1000 carbon atoms in the world, 989 will be C-12, while only 11 will be C-13. When people eat lots of corn, their bodies end up with more C-13 than what's found in the surrounding environment.



*The circles are cross-sections from femurs (upper leg bones). The upper circle (A) is from a Prehistoric native person in the Florida / Georgia region. The lower circle (B) is from a Mission-period native. Note the thicker bone in sample B.*

# CHAPTER NINE

## ARCHAEOLOGY-BEYOND EXCAVATION

Heavy nitrogen (N-15) is more common in marine environments. It also becomes more concentrated the higher up you go in the food chain. So eating a shark will give you more N-15 than eating a mullet. And eating a mullet will give you more N-15 than eating a raccoon. For every 1000 nitrogen atoms, 996 will be N-14, with only 4 being N-15. So, a person eating lots of seafood will have greater than four N-15 atoms per 1000 nitrogen atoms.

Data shows that the amount of C-13 increases in skeletal samples during the mission period. This corresponds to an increase in the eating of corn. At the same time, the amount of N-15 decreases. Why? Eating marine fish gives the highest levels of N-15, followed by freshwater fish, then by land animals, and finally by corn and beans. When the N-15 levels at mission sites drop, it indicates that the native people were relying less on fishing and more on farming, with some hunting. Interestingly, the coastal villages had higher levels of N-15 than the inland villages. They may have been fishing less than in the olden days, but the isotope data shows they were still eating plenty of fish.

**Archaeology Note:** There has been a lot of controversy about when corn was first grown in Florida. The French and Spanish left plenty of documents describing the fields of native corn they found (and plundered) during the mid-1500s. But when did the Timucua actually start growing corn? Plant materials normally decompose over time, so there aren't many corn cobs or corn kernels found at archaeological sites. Instead, archaeologists look for other evidence that might pinpoint the dates of corn cultivation. They look for corn pollen in human coprolites (petrified poop) and for pottery that is cob-marked (impressed with corn cobs before the firing process).

They also look at human bone isotope levels. These studies show that before 1450 CE, bones found in pre-Timucua burial sites had a fairly consistent level of C-13. After 1450 CE, the levels of C-13 increase a lot. This suggests that the Timucua first started growing corn around 1450 CE, only 100 years before European contact. The evidence was surprising, because corn pollen collected near Lake Okeechobee had suggested that corn was cultivated as early as 450 BCE. New technologies like isotope analysis have allowed archaeologists to establish that corn cultivation actually began much later.

### STUDYING ANCIENT PEOPLES THROUGH TRIAL AND ERROR

No matter how much we look through a microscope, no matter how many interesting artifacts we excavate, there are some things that can only be learned through trial and error. If you really want to figure out how native peoples carved a canoe, wove a fishing net, fashioned shell tools, or built a hut, there's no substitute for trying it yourself. One modern Floridian, Dr. Robin C. Brown, did just that. He practiced experimental archaeology for five years while doing research for his book, *Florida's First People*. He taught himself the following Timucua technologies, using only native materials (no power saws allowed).

# CHAPTER NINE

## ARCHAEOLOGY-BEYOND EXCAVATION

- 1) Starting a fire with a self-made bow drill
- 2) Knapping stone tools using heat-treating technologies
- 3) Coiling pottery and firing it
- 4) Weaving cord, rope, baskets, mats, cloth, and fishing nets using a variety of plant fibers
- 5) Creating tools like shell axes and sharks tooth knives
- 6) Tanning deer hides
- 7) Making wooden tools, like a mortar and pestle
- 8) Processing and cooking nuts, acorns, cattails, coontie, and corn for consumption
- 9) Collecting and cooking shellfish, including whelk and coquina
- 10) Processing Yaupon holly and making the Black Drink

His research goal was to develop a feel for the skills that Florida's native peoples needed to survive. The book has provided modern Floridians with a better understanding of the life skills of native peoples. It has also aided primitive technologists, the people who create realistic replicas of native tools for nature centers and museums. After many requests, Robin Brown wrote a version of his book for younger readers. It's called *The Crafts of Florida's First People*.

### WHAT IS EXPERIMENTAL ARCHAEOLOGY?

Experimental archaeologists follow two basic methods. Both take place after plenty of research. The first is the "jump in and just figure out how they did it" method. Robin Brown worked this way. He kept trying different ways of making a shell hoe until something worked.

The other method involves painstaking (and often tedious) analysis of wear patterns on ancient and modern replica tools. They want to identify which tasks create which types of wear on the tools. For example, if you use a shell chisel to make a canoe, all that chipping will create cracks and scars on the chisel. A chipping tool develops different wear marks than a tool used for pounding or cutting. Once an archaeologist can recognize the wear pattern on modern replica tools, he can study actual artifacts to look for the same use-wear patterns. This helps archaeologists to figure out how ancient artifacts were used as tools.

One of the most popular experimental archaeology projects seems to be constructing dugout canoes. Several colleges and other groups have attempted this with varying degrees of realism. Some use chainsaws to cut down the tree needed for canoe-making. Others make a separate experiment of using fire and shell axes to fell the tree. Some cut the initial canoe shape with modern tools, while others stick to native tools for the whole job. One group even made the many shell tools needed for the task. These experimental archaeologists learn by trial and error how to control the fire used to char and soften the interior of the canoe. Many give up part way through and resort to using modern tools to finish the project. Others stick with native technologies until they see that canoe float. Regardless of

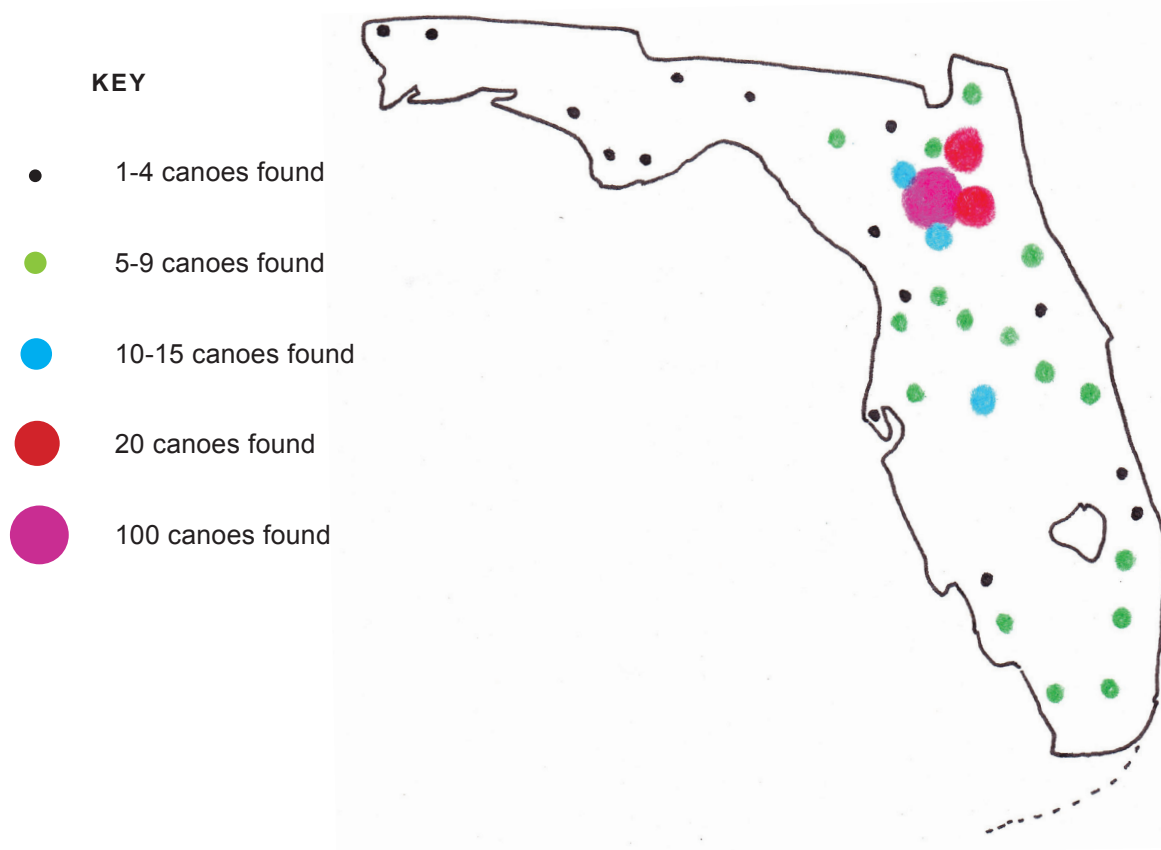
# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

individual successes and failures, every one of these studies provides us with a greater understanding of native life.

You may be wondering why we need to make modern dugouts. Aren't there hundreds of old dugouts being found around the state? As a matter of fact, there are. In the year 2000, droughts had really lowered the water levels at Lake Newnan in the Gainesville area. An AP Environmental Sciences class from a local high school discovered some ancient dugouts while on a fieldtrip. Archaeologists surveyed the site, finding a total of 101 canoes. These dugouts ranged in age from 500 to 5,000 years old. Most were made of pine, with a few cypress mixed in. The wood had degraded so much (some of it was the texture of wet cardboard) that the canoes could not be moved or preserved. Samples were taken for study, and the canoes were left in situ.

*This map shows the locations of native canoes preserved in wet sites around Florida. The original maps were created by L.A. Newsom in 1982 and R.M. McGee in 1987.*



# CHAPTER NINE

## ARCHAEOLOGY- BEYOND EXCAVATION

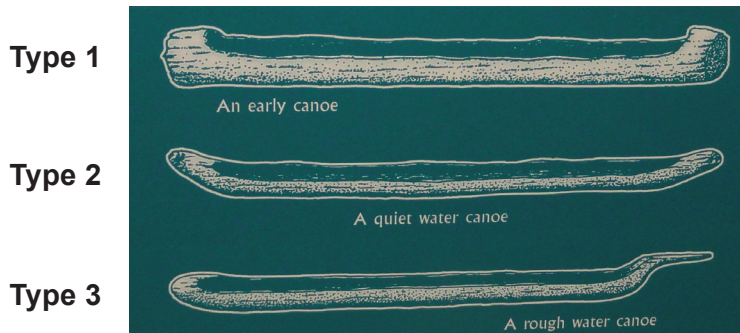
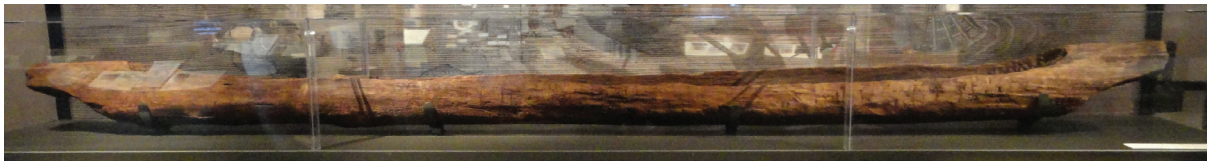
*These recovered canoes and paddles are on exhibit at the Florida Museum of Natural History in Gainesville.*



**Above Left and Below:** 500-year-old pine canoe, made by the Timucua.



**Above right:** Toy Canoes, found in Volusia and Putnam Counties (in or near pre-Timucua territory).



*This artist's rendering at the Florida Museum of Natural History depicts an archaic canoe (1.) which was used prior to 500 BCE. The two lower canoes were made by both prehistoric and historic peoples (2. & 3.) from 500 BCE to the 1700s CE. Contact Period canoes differ mainly in the use of iron tools during construction.*



**Right:** Florida canoe paddles and poles ranging from 260 BCE to 1420 CE.

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### ACTIVITY – IDENTIFYING FLORIDA CANOE TYPES:

**INSTRUCTIONS:** Compare the canoes in these photos to the Type 1, Type 2, and Type 3 canoes in the illustration. Use both the images and their accompanying text to make an educated guess about which type of Florida canoe each represents.

Ancient canoes preserved in peat or marsh mud are usually quite degraded. They're flattened because of the weight of the muck pressing down on them, and they're often missing one or both ends.

*The canoe to the right is 1,100 years old. It was found in 2011 in Tampa's salt marsh flats. The 11.6 meter (38') canoe was missing one end. It was cut into 3 meter (10') sections to make it easier to transport and then soak in a preservation bath. After about 2 years, it will be reassembled and displayed at Weedon Island State Park (outside Timucua territory).*



A. This canoe is probably Type \_\_\_\_\_, because \_\_\_\_\_

\_\_\_\_\_



*The replica canoes in the photo below were created as a part of an experimental archaeology project at Crystal River State Archaeological Site (outside Timucua territory).*

*Courtesy of [www.EpicRoadTrips.us](http://www.EpicRoadTrips.us)*

B. These canoes are probably Type \_\_\_\_\_, because \_\_\_\_\_

\_\_\_\_\_

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### ACTIVITY – IDENTIFYING FLORIDA CANOE TYPES continued:



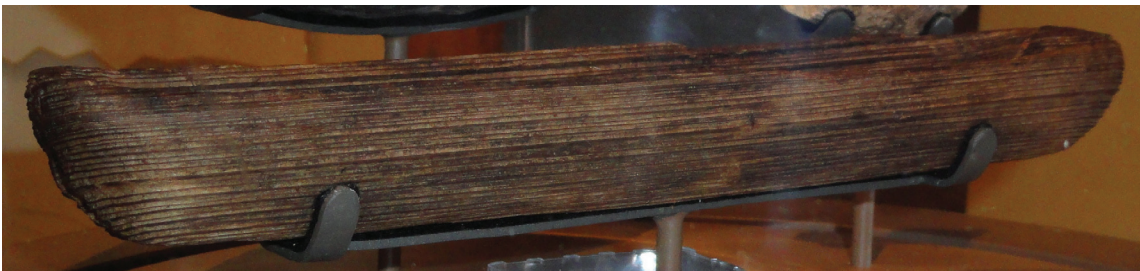
*This Florida canoe is on display at the Ft. Caroline National Memorial in Jacksonville, FL. It was discovered near Gainesville (40 miles from the Gulf Coast, in Timucua Territory). It has been tentatively dated to 500 years ago.*

C. This canoe is probably Type \_\_\_\_\_, because \_\_\_\_\_  
\_\_\_\_\_



*This canoe is on display at the Florida Museum of Natural history in Gainesville. It was found in Florahome, FL, Putnam County (about 30 miles from the Atlantic Coast, in Timucua Territory). It is dated to 400 years ago.*

D. This canoe is probably Type \_\_\_\_\_, because \_\_\_\_\_  
\_\_\_\_\_



*This toy canoe is on display at the Florida Museum of Natural History. It was found in Satsuma, FL and has been dated to 480 BCE. Satsuma is in Putnam County, within Timucua Territory.*

E. This canoe is probably Type \_\_\_\_\_, because \_\_\_\_\_  
\_\_\_\_\_



# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### EXPERIMENTAL ARCHAEOLOGY – CANOES

Incredible finds, like the mass of canoes at Newnan's Lake, often raise more questions than they answer. Why were so many canoes found there? Why did most of the discovered dugouts date to around 700-950 CE? Why are most made of pine, with only a few made from cypress?

Hydrology (the study of how water moves across land) may provide an answer to the first question. At times of high water in Florida history, isolated lakes were connected into flowing rivers, making canoe highways across the state. During times of low water (droughts) the connecting river highway disappears, and even the lakes dry up into mud-filled holes. When many canoes are discovered together, archaeologists think they might have been abandoned due to low water levels. Another theory notes that some cultures sank canoes on purpose to protect them from weathering or theft while the owners were away. We can only guess why they never returned for their canoes.

Both geology (the study of processes that shape the earth) and hydrology offer insights about the age of the discovered dugouts. The canoes were found in mucky peat at the bottom of lakebeds. These peat deposits started forming 6,000 years ago, so it makes sense that the oldest canoes are in the 5,000-year range. Many of these ancient canoes may have been destroyed when water levels dropped and exposed the canoes to oxygen. Only a few survived from these times. Because so many canoes date from 700-950 CE, archaeologists believe the pond has been consistently full of water since that time. In fact, the drought that exposed them and allowed their discovery may represent the lowest water level in 1,300 years). But why aren't we finding more recent canoes, from the Contact Period, for example? Only further study can tell.

The final question, about the use of pine vs. cypress, is one that can be addressed by experimental archaeology. Here are some of the conclusions drawn by participants in several different canoe projects.

- 1) **First, our answer about wood type:** Pine is easier to work than cypress. Why? Its pitchy sap helps it burn more easily. Then charred wood can be scraped out instead of chopped out.
- 2) Chopping unburned wood with stone and shell tools leaves permanent chips and gouges in the tool blades. This damage is very specific, so actual artifacts can be studied to see if they show the kinds of use-wear marks left by woodworking.
- 3) You needed a big tree to start with, perhaps 20' long x 3' in diameter.
- 4) Felling a tree with fire takes up to 18 hours. Felling a large tree using only stone tools takes about 30 hours. Perhaps native peoples girdled good canoe trees earlier in the season to weaken them. (Girdling is cutting through the bark all the way around the tree to prevent the transport of water and minerals up the tree.)

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

- 5) While charring the wood, wet clay should be slathered across any wood you don't want burned, including depressions that might burn through. The fire's heat hardens and cracks the clay, so it must be replaced with fresh, wet clay after each burning event.
- 6) A wooden scoop to remove hot coals is helpful to prevent burned fingers.
- 7) If the pine log is sufficiently charred, wooden tools work just as well as stone for scraping away the charred layer.
- 8) The wood debitage created by canoe making is made up of long, narrow strips. These strips are exactly as wide as the blade on the shell tool used to chip them.
- 9) You shouldn't allow the felled tree to dry before starting canoe manufacture. It causes cracks to develop.
- 10) Elevating canoe logs on stands allows wood workers to reach all sides of the log and is easier on the back.
- 11) If you burn a canoe log for 2-3 hours a day, it will take you 17 days to complete the canoe (using native tools and methods). A one-inch layer of wood is removed per day.
- 12) Burning the base of the canoe from the bottom, with the heat billowing up into the canoe base, is too uncontrolled. Native peoples probably rolled the canoe so its base faced upwards. The base could be burned and worked in a more controlled (if slower) manner.
- 13) The inside of the canoe must be scoured with sand and an abrading tool to make it smooth enough to sit in.

### ACTIVITY – TESTING CANOE STYLES:

**BACKGROUND:** In Florida, archaeologists have observed three basic canoe styles.

**Type I** canoes date from the Archaic Period (2,500–500 BCE). They are very basic structures. The bottoms of these canoes are not angled up in the front and back. In fact, the ends are identical, so there's not actually a front or a back. The chipping work on the outside is often incomplete, even leaving the bark on in some spots.

**Type 1**



An early canoe

**Type 2**



A quiet water canoe

**Type 3**



A rough water canoe

*Three styles of Florida Canoe  
An illustration from the Florida  
Museum of Natural History*

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

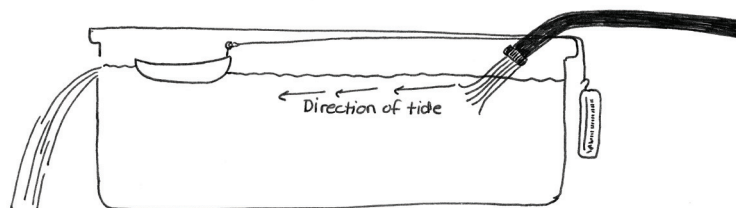
### ACTIVITY – TESTING CANOE STYLES *continued*:

**Type 2** canoes date from the early prehistoric into the historic periods (500 BCE – 1700s CE). The bottoms of these canoes are angled up in the front and back. The front of the canoe has a gentler angle, allowing water to flow around the canoe more smoothly. It's more hydrodynamic than the back. The outside of a Type 2 canoe is smooth and free of bark.

**Type 3** canoes were also used from 500 BCE to the 1700s CE. The back of the canoe angles up a bit, but not as sharply as Type 2. The real difference is the front, which has a long, wide prow. The prow created buoyancy for cresting over waves and rough water. The front is also much more V-shaped. This helped it to cut through water at high speeds. This canoe was designed to go offshore, while Type 2 was used in rivers, lakes, and smooth tidal flats.

**INSTRUCTIONS:** You will be using miniature canoes carved from styrofoam to test the effectiveness of Type 1, Type 2, and Type 3 canoes. Each canoe will be tested in three water environments: tidal marsh, rough intracoastal waters, and calm lakes. Your goal is to determine which of the three canoe shapes works best in each environment. Before you begin, formulate a hypothesis rating the various canoe types for each environment.

**Station A – Tidal Marsh:** Paddling against the tide takes a huge amount of effort. A canoe that moves more easily through the water (creating less friction) is said to be “hydrodynamic.” Hydrodynamics is the study of how fluids move around objects. In this lab, you'll be measuring the force required to propel each canoe type through the water. The flow of the tide will be simulated by running a garden hose into the tub. The weight of the spring scale will pull the canoe forwards.



In a tidal marsh, the most hydrodynamic canoe is the one that requires the least force to propel it through the tide. You can measure this force with a spring scale attached to the canoe with fishing line. The fishing line should be long enough to reach the entire length of the tub (or gutter, whichever your class is using) PLUS enough to dangle over the rim of the tub and support the hanging spring scale. How long will your line be? \_\_\_\_\_

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### ACTIVITY – TESTING CANOE STYLES *continued*:

Attach one end of the fishing line to an eye screw on the front end of your canoe. The other end attaches to the spring scale. Set the canoe into the water at the far end of your tub. Hold the spring scale and walk around to the opposite end of the tub, stretching the line so that it rests on the upper lip of the tub edge. A teammate will turn on the hose, to a pre-determined (and constant) flow, for example, 6 turns of the spigot. He will place the running hose into the water opposite the canoe to simulate the force of the tide. Release the spring scale so it dangles, allowing it to read the number of Newtons (force) required to move the canoe against the tide. As the boat struggles against the flow, read the spring scale and record the force in Newtons. You will probably be rotating through stations, so you may need to wait until your next rotation arrives to test the next canoe type. The canoe requiring the least amount of force is the most efficient in a tidal environment.

Type 1 requires \_\_\_\_\_ Newtons.      The best canoe type for a tidal environment

Type 2 requires \_\_\_\_\_ Newtons.      is \_\_\_\_\_.

Type 3 requires \_\_\_\_\_ Newtons.

**Station B – Smooth Lake or River:** You'll use a different method to test hydrodynamics in still water. Attach one end of your line to an eye screw in the canoe you're testing. Attach the other end to a fishing weight. Set the canoe at the far end of the tub. Then stretch the line across the length of the tub so that it rests on the upper lip of the tub. A teammate should be standing by with a stopwatch. When he says, "go," release the weight. As gravity pulls it downward, the string will pull the boat forward through the still water. When the canoe touches the close end of the tub, stop the stopwatch. Record the length of time it takes for the weight to pull this canoe through the water. Repeat the experiment with the other two canoes as the rotation permits. The canoe that covers the distance fastest is most hydrodynamic. It would be the most valuable canoe type for Timucua living in a still water environment.

Type 1 took \_\_\_\_\_ seconds.      The best canoe type for still water

Type 2 took \_\_\_\_\_ seconds.      is \_\_\_\_\_.

Type 3 took \_\_\_\_\_ seconds.

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### ACTIVITY – TESTING CANOE STYLES *continued*:

**Station C – Rough Open Water:** Paddling through waves adds another element – the possibility of waves swamping your canoe. Developing a canoe that would maintain its buoyancy even in rough water would be essential in a maritime environment. This process is similar to Station B. Attach one end of your line to an eye screw in the canoe you’re testing. Attach the other end to a fishing weight. Set the canoe at the far end of your tub, and gently stretch the line across the length of the tub so that it rests across the tub’s rim. Before releasing the weight, one teammate should agitate the water to create waves. Another teammate should be standing by with a stopwatch. When he says, “go,” release the weight. Gravity will pull the weight downward, tugging the canoe forward through the choppy water. When the canoe touches the close end of the tub, stop the stopwatch. Record the time it takes for the weight to pull this canoe through the water. Repeat the experiment with the other two canoes as the rotation permits. For consistency, have the same teammate agitate the water during each trial, using the same motions. The canoe that covers this distance the fastest is most hydrodynamic. It would be the most valuable to the Timucua in a rough water environment.

Type 1 took \_\_\_\_\_ seconds.

The best canoe type for still water

Type 2 took \_\_\_\_\_ seconds.

is \_\_\_\_\_.

Type 3 took \_\_\_\_\_ seconds.

Record your observations and your conclusions on the lines below.

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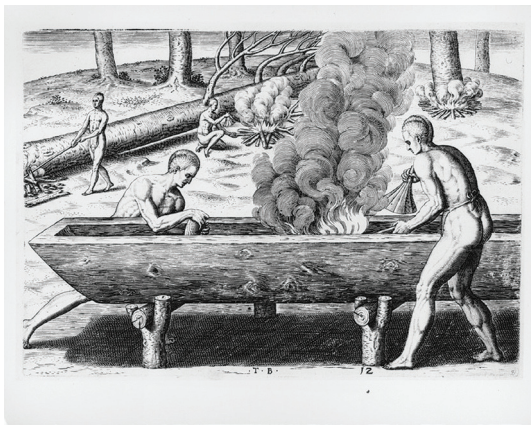
# CHAPTER NINE

## ARCHAEOLOGY-BEYOND EXCAVATION

### CANOE MANUFACTURING CENTERS

With so many canoes found at Lake Newnan, doesn't it seem likely that a canoe-making center was located nearby? No such place has been found in the southeast. In fact only one has been found on the East Coast of North America, way up in Massachusetts. What would a native person have looked for when choosing a spot to manufacture canoes? They'd want nearby access to large trees – or at least a way to float the logs to the manufacture site. They'd also need fuel for the fires that must burn for several days. Access to clay and water would have been important for fire control. And finally, they'd need a way to launch new canoes into the water to test them.

What would an archaeologist look for if she were searching for a canoe-manufacture site? The site would have lots of charcoal, ash, wood debitage, and broken or worn out shell tools. She might also look for postholes left by canoe support frames.



*This de Bry engraving shows the Algonquin people of North Carolina using fire in the canoe making process. The entire process is illustrated here.*

*Upper right, a tree is being felled using a fire burning at its base. Upper far left, a man is using fire to “cut” the log to the proper canoe length. Upper middle, a man is using fire to remove large branches. In front, the men are using fire to char the interior of the canoe so they can scrape out the wood. Notice that the canoe is resting on supports.*

*Courtesy of the British Museum*

### THE DETAILED SIDE OF EXPERIMENTAL ARCHAEOLOGY

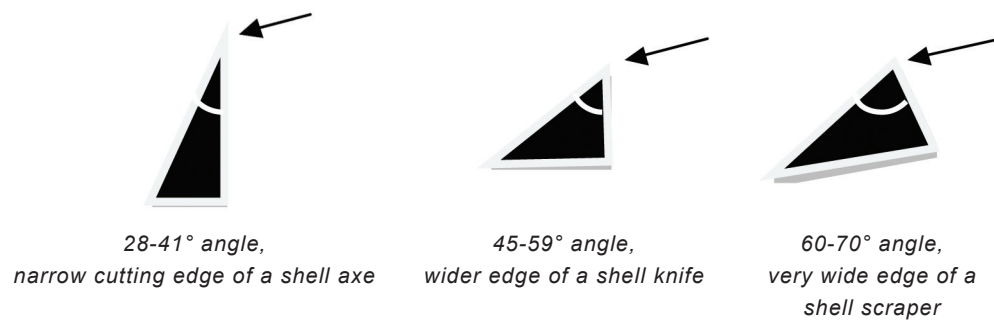
Many experimental archaeology studies have been performed on STONE tools. These archaeologists start by making their own stone tools (like stone axes), then use the tools (chop wood), and record the use-wear patterns that show up on the stone (chips and cracks on the axe blade).

In the 1980s, a few experimental archaeologists adapted these stone use-wear studies to the SHELL tools found in Florida. What is “use-wear”? It is the damage done to the working surfaces and edges of a tool through everyday use. Archaeologists were looking for areas on the shell tools that were broken, cracked, scratched, or rubbed to a shiny polish. They learned that shells used as axes took on one kind of damage, while shells used to pound nuts were damaged in a completely different way. This information helps archaeologists identify the purpose of ancient tools, which rarely look like a chisel, axe, or hammer. They just look like...old shells. The following list reviews some of their use-wear conclusions.

# CHAPTER NINE

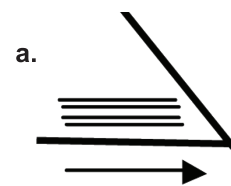
## ARCHAEOLOGY - BEYOND EXCAVATION

- 1) If an item was hafted (mounted on a handle), it will probably have holes or notches cut through the outer whorl where the handle was inserted.
- 2) Old shells are the largest, but they're too brittle to make large chopping and pounding tools like axes and hammers. When archaeologists study the use-wear on large shell artifacts, they do find wear marks (like scratches and polishing), but not cracks. This suggests that large shell tools were used for a purpose other than chopping or pounding.
- 3) The angle of the shell's working edge is directly related to the amount of damage on the shell. Smaller angles (28-41°) showed the most impact damage and were designated as chopping tools. Medium angles (45-59°) showed less impact damage and were designated as cutting tools. Larger angles (60-70°) showed very little impact damage and were categorized as scrapers. In the image below, the arrows show the cutting edge of the tool.



- 4) The shells with the smallest angle blades were woodworking tools called celts (pronounced: selt). The many impact scars were big enough to be seen with the naked eye. If the working edge had become dull through use, and someone kept using the shell anyway, it showed layers of tiny fractures. This was only visible through a 100-power microscope.
- 5) Organic plant residues were found imbedded in the impact scars and cracks on many of the tools. When viewed under a stronger microscope (200-power), these residues looked glossy. When viewed under 400-power, the glossy areas were filled with tiny striations (lines) that were all in one direction. The shell tool had been repeatedly rubbed or struck in a particular direction, leaving these lines.

Figure a. If the striations were parallel to the working edge, the tool was used for sawing, which is a back and forth motion along the same axis as the blade. Think about using a modern saw.



# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

Figure b. Some striations that were perpendicular to the working edge indicated tools used for cutting or slicing. Slicing a carrot, for example, you press the knife down through the carrot. Any lines scratched into the knife (by the material being sliced) would also be up and down, perpendicular to the blade.

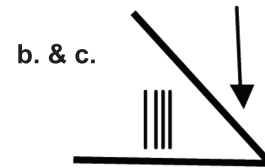


Figure c. Other times, striations at that same 90° angle indicated use as a carving or whittling tool. Imagine the movement of someone's hands while they're whittling wood with a pocket knife, and you can see how the striations would also be perpendicular to the blade.

### EXPERIMENT – USE-WEAR STUDIES ON WOODEN TOOLS:

**BACKGROUND:** Throughout history, wooden tools have been used for a variety of purposes, including digging sticks, pestles for pounding, and tool handles. In this activity, you will start by using wooden tools to build up a wear pattern. Then you will inspect the wooden tool for signs of wear that indicate use.

**INSTRUCTIONS, Part I:** Your class will be presented with several wooden tools made from modified dowels. You will move from station to station, using the tool as directed so that it can develop a wear pattern. For digging sticks, you will push the sharpened end into the soil, as though you are trying to dig up an edible root. For pestles, you will pound the flat end of the dowel into dried corn or acorns, crushing them against a hard surface (a concrete surface is okay). For tool handles, you might have a shell hoe, perhaps a whelk or clam shell attached to a dowel handle. You can use any binding material (even packing tape) as long as the shell is tightly bound. Use this shell hoe for hoeing up the dirt in preparation for planting. The force of the shell against the wooden handle should leave identifiable stress marks. Each tool's working edge should be photographed before use and again after the first use and after the final use.

Before you try each of the three tools, examine the tool for damage. Repeat this observation after you use the tool. Record your observations below.

1a. Digging Tool: Pre: \_\_\_\_\_

Post: \_\_\_\_\_

1b. Pounding Tool: Pre: \_\_\_\_\_

Post: \_\_\_\_\_



# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### EXPERIMENT – USE-WEAR STUDIES ON WOODEN TOOLS continued:

1c. Handle: Pre: \_\_\_\_\_

Post: \_\_\_\_\_

**INSTRUCTIONS, Part II:** Your class will return inside. The shell will be removed from the wooden handles of the hoes. Your teacher will photograph the use-wear on these handles. Students will visit each station and examine all three tool types - both with the naked eye and with a magnifying glass. In the space below, record any signs of wear. Which signs show up only with magnification?

2a. Digging Tool: Naked Eye: \_\_\_\_\_

Magnifying Glass Only: \_\_\_\_\_

2b. Pounding Tool: Naked Eye: \_\_\_\_\_

Magnifying Glass Only: \_\_\_\_\_

2c. Handle: Naked Eye: \_\_\_\_\_

Magnifying Glass Only: \_\_\_\_\_

**INSTRUCTIONS, Part III:** Your teacher will shuffle the tools so that you will not know which kind you are examining. You will examine three different tools. You may have one of each tool type, or three of the same tool type. Apply your observations about tool wear to try to figure out what each tool was used for.

3a. How was your first tool used? \_\_\_\_\_

What is your evidence for this conclusion? \_\_\_\_\_

3b. How was your second tool used? \_\_\_\_\_

What is your evidence for this conclusion? \_\_\_\_\_

3c. How was your third tool used? \_\_\_\_\_

What is your evidence for this conclusion? \_\_\_\_\_

# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### EXPERIMENT – USE-WEAR STUDIES ON WOODEN TOOLS *continued*:

4. Write a short paragraph for inclusion in an archaeology textbook, describing how to identify wooden tools through wear analysis. Remember, it's the obligation of every archaeologist to record detailed observations (take notes) and to publish his findings (share his conclusions).

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# CHAPTER NINE

## ARCHAEOLOGY - BEYOND EXCAVATION

### ACTIVITY – EXAMINATION OF DEBITAGE:

**BACKGROUND:** Native tool makers used shell axes to chisel wood out of canoe logs. Each axe produced chips of exactly the same width as the working surface (blade) on the shell tool. After the Timucua got metal tools from the Spanish, canoe construction began to produce unique iron axe debitage. Comparing the debitage found at native sites tells archaeologists a lot, even in the absence of actual artifacts.

When you created a soap carving in the Tool Technology unit, your teacher collected a sample of soap debitage created with wooden tools. She also carved a sculpture of her own, using a metal knife. This produced a completely different kind of debitage.

**INSTRUCTIONS:** Use a ruler and magnifying glass to observe both groups of debitage. Are the sizes of the chips in each group uniform? Or did each tool produce chips of varying sizes? Is the debitage produced by one tool consistently smaller, thinner, or distinctively shaped when compared with the other?

Measure 5 pieces of debitage (length, width, and if possible thickness) in millimeters. Take an average for each dimension. Record your data here.

Five Lengths: \_\_\_\_\_ Average: \_\_\_\_\_

Five Widths: \_\_\_\_\_ Average: \_\_\_\_\_

Five Thicknesses: \_\_\_\_\_ Average: \_\_\_\_\_

Write a statement to be included in an archaeology handbook regarding the differences in debitage created by wooden tools vs. metal tools. Data describing metal-created debitage can help archaeologists demonstrate contact with Europeans even if no European artifacts are found in the excavation.

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