

Bronze Disease: Understanding, Curing, and Preventative Treatment

Jason Sanchez

Associate, American Numismatic Society
Member, Crescent City Coin Club

Dr. Ken Harl, Ph.D

Tulane University History Department
Fellow and Trustee, American Numismatic Society

Agenda

Bronze Disease: Understanding, Curing and Preventative Treatment

- ◆ What is Bronze Disease?
- ◆ Do I have a Patina, or Bronze Disease?
- ◆ If I have Bronze Disease, what do I do?
- ◆ Long-term care: serious storage concerns

What is Bronze?

Before we find out about Bronze Disease, first, the more important question: **what is Bronze?**

- ◆ An alloy of Copper (CU) of more than 90% purity in conjunction with other metals (usually tin, antimony and zinc)
- ◆ One of the first metals used by man – “Bronze Age” man dated from c. 3,000 BCE in Asia Minor, but the use of bronze is noted in some parts of Asia (Chiang Mai, Thailand and Sanxingdui, China) by c. 4,500 BCE
- ◆ American Pre-Columbian use of Bronze may have begun by 1000 CE
- ◆ Bronze was one of the first metals that was used for coinage
- ◆ Bronze coinage by far outstrips silver or gold as a constituent of the money supply for most countries up to the modern age

What is Bronze Disease?

- ◆ Bronze “disease” is a condition in which the coin produces acid (normally hydrochloric or hydrosulfuric acid) internally, and begins to disintegrate
- ◆ The exterior usually exhibits green or brown “growths” that cover the pitting that acids will create
- ◆ Because these growths were originally believed to be caused by a bacteria, the condition became known as bronze “disease”
- ◆ Early numismatists actually tried to soak their coins in anti-bacterial washes to prevent the disease – this probably only made matters worse!

“Green fuzz” – an early stage warning sign



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“Green fuzz” – an early stage warning sign



Green isn't necessarily bad, however

- ◆ This can be indicative of a patina, an oxidizing layer which actually protects the coin
- ◆ Some collectors – particularly of East Asian coins – buy and sell coins exclusively based on their patinas
- ◆ A patina is normally more uniform – it covers the entire coin – and is a duller shade of green than bronze disease



Patination vs. Bronze Disease

- ◆ A patina is a naturally occurring oxidation layer usually formed of copper chloride and copper oxides
- ◆ Many artists in particular attempt to create patinas, such as those found on works by New Orleans sculptor Enrique Alferez or the Statue of Liberty
- ◆ A patina is structurally safe and will protect the metal - **so long as** it is not disturbed by extremes of heat, humidity, acids, or environmental pollutions



Do I have a Patina, or Bronze Disease?

This may be the most important question you ask. A patina is safe; bronze disease is not.

- ◆ Does the coin come from an area known to be subject to Bronze Disease? (Britain, Australia, southeastern China, parts of Europe)
- ◆ A region with relatively high humidity throughout the calendar year
- ◆ A region whose trace elements (tin, antimony, zinc) are impure or are known to occur in the presence of sulfur
- ◆ A region that has high amounts of sulfur or chlorine in the atmosphere, from oil refining or naturally-occurring in swamplands

Do I have a Patina, or Bronze Disease?

This may be the most important question you ask. A patina is safe; bronze disease is not.

- ◆ Is the “green part” universally on the coin, or occurring only in one or two places?
- ◆ Can you “scrape off” the green part with a stiff toothbrush, a toothpick or fingernail?
- ◆ Is pitting occurring on the coin, or are there nicks in the rim?
- ◆ Is the coin acidic if you place it to a pH test? (e.g. 0-4)

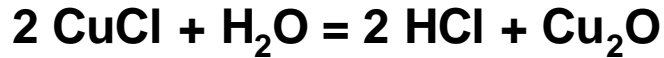
Answer “Yes” to any of these questions and you probably have **bronze disease**

Pitting: The Patina is Covering the Reality that Acid is Eating the Metal Coin

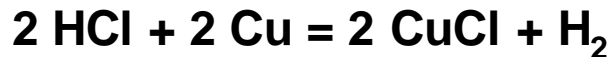


What is really going on?

The copper chlorides mix with water vapor in the air and create a chemical reaction.



(stage one complete)



(stage two. Note that $2 \text{CuCl} + \text{H}_2$ creates a sustaining reaction)

Sulfur or other impurities may create variations with hydrosulfuric acid rather than hydrochloric acid. Reaction triggers include harsh handling/treating, sudden environment change, and prolonged exposure to humidity.

Now that I have Bronze Disease, what do I do?

Unlikely to be able to get “professional” help from museums, because:

- ◆ Liability, insurance issues
- ◆ Some larger, international dealers may have a buy-back policy or offer assistance
- ◆ But generally ...

You're on your own.

Be patient. This is going to take a long time.

Getting Physical – Cooking with Coins?!?

So I say to myself, “SELF! Humidity is really excess water. Let’s evaporate out the water, and then the damaging corrosive element is gone! So ...

Put your coins on a cookie sheet in the oven, bake at 375° for 45 minutes, let cool, and BAM!

Sadly, this method *won’t work* permanently, as although this DOES get rid of the humidity temporarily, it will just come back.

Plus, it will darken your coins permanently.

Getting Physical – See your dentist twice a year?!?

Start by using a FIRM or HARD nylon toothbrush, and gently scrape the excess green discharge off the coin. For firmly lodged debris, you can use a toothpick or sharply pointed chopstick

Be VERY CAREFUL if you use X-acto style knives or Dremel sets, as these could permanently scrape and damage your coins.

Soak the coins in distilled water (NOT artesian or still tap water) for 10-15 days to release the chlorides

This may seem counter-intuitive: the problem is water, so why soak it in water? But distilled water is chemically “squeaky-clean” and will actually serve to reverse the chemical process

Some mild cases and early-stage problems can be prevented in this manner, but generally you will need to have stronger remedies.

Getting Chemical – Fighting Acids with Bases

Tough Cases:

Sodium Sesquicarbonate

Place the coins in a glass container and fill with a 5% solution of sodium sesquicarbonate. Let them soak for about 14 days, replace the solution, and soak for another 14 days. Then, place the coin in distilled water for about a week.

Don't have sodium sesquicarbonate lying around? You can make it with equal molar amounts of sodium carbonate (also called soda ash) and sodium bicarbonate (yes, you know what that is). For example, a 5% molal solution would be 10.6g of carbonate and 8.4g of bicarbonate in 100ml of water.

A 5% solution WILL REMOVE any "patina" on the coin! If there is an exceptionally aesthetic "patina" to be preserved, try a 1% or 2% solution. Be warned, though, that it will take three times as long, and has a higher risk of being ineffective.

The Beauty of a Green Patina ... Can be completely stripped off through cleaning!

Getting Chemical – Fighting Acids with Bases

Alternate: Fish-tank Cleaning Solutions

Don't feel up to re-mastering your high school chemistry? No Problem!

Use a fish-tank cleaning solution. This is a pre-mixed base which you can add into distilled water.

Soak your coins for 2-3 days, followed by a quick rinse of the vessel, and another continue with another soak for 2-3 days, followed by 2-3 days of soaking in distilled water only.

You may have to repeat this process up to 10 weeks for stubborn cases!

Getting Chemical – The Heavy Guns

BENZOTRIAZOLE (BTA)

Dissolve benzotriazole in ethanol (6-7% solution) and soak the coin from 1 hour to 2 days.

Following this step, move the coin back into distilled water for 1 week to rest it.

If working with these chemicals PLEASE use appropriate safety equipment and work in a well-ventilated area

BTA will typically clear up any lingering problems and is often used as a “sealant” just before the coin is finally finished being cleaned.

WARNING – BENZOTRIAZOLE IS A KNOWN CARCINOGEN

WARNING – ETHANOL IS A DANGEROUS CHEMICAL AND CAN BE DIFFICULT TO PURCHASE

Storage – Your Final Worry

After 5-15 weeks of treatment, your coins have been rid of bronze disease and are perfectly clean

Now what? Leaving them alone will only allow the problem to repeat!

Storage – Your Final Worry

Some numismatists like to cover their coins in “Renaissance Wax,” or Polyvinyl Acetate Lacquer, which are microcrystalline waxes which prevent humidity from re-entering the coins

This is the preferred treatment method of the British Museum

Unfortunately, it also makes the coin worthless to a collector, very difficult to ever clean again, and it’s very hard to remove



Storage – Your Final Worry

If you can't do anything else, place your coins in inert plastic containers filled with **silica gel** (available at most packing or moving stores) and replace the silica gel at regular intervals.

This will absorb some of the moisture and generally keep the humidity low. However, silica gel must be either replenished or rested regularly in order to maintain its quartz-like properties. It can also, of course, be dangerous for children to eat.



Storage – Your Final Worry

A much better, long-term solution is to purchase a **dehumidifying cabinet**. These are commonly used in the technology and medical industry to prevent corrosion on expensive components such as semiconductors.

Humidity levels below rH 35% should prevent the conditions permitting the acid reactions from occurring.

Cabinets can be extremely expensive, but businesses purchasing them may be eligible to deduct them for tax purposes (see your tax or financial advisor).

Although the larger cabinets are too expensive for the average collector, if you have an extensive collection that is insured, having it in a dehumidifying cabinet may qualify you for lower insurance premiums (again, see your tax or financial advisor).

Small cabinets may still be affordable, but you might also consider a large-scale dehumidifier for your home – which will lower humidity for clothes, rugs, paper, etc.

Recap – Which Coins Should I Worry About?

Bronze coins with high levels of trace elements

(Gold and Silver, obviously, aren't a problem.)

Bronze exnumia (statuettes, doubloons, etc.) with high bronze levels

Bronze weapons, eg. swords, knives, etc.

Any items which have recently been “disturbed” – moved from storage, moved into storage, etc.

Legal Indemnification and Contact Information

There is no guarantee, suggested, expressed or implied, that the preceding methods are appropriate or suitable for your own collection, nor that they will work on each coin, nor that they will succeed in each case. Where possible always consult with a professional conservator.

Jason Sanchez
Office: 595-5486

Dr. Ken W. Harl, Ph.D.
kharl@tulane.edu