

Containers of Antiquity

We Live Within Our Waste

Today, large swaths of the oceans contain our floating discarded plastic (ref [1]). This society makes these one-use containers for our “you only live once” (YOLO) convenience (ref [2]). Mother Earth has never encountered any of these hydro-carbon plastics before. Much of this single-use plastic is meant to last. Did soda marketers expect a polyethylene terephthalate (PETE) (ref [3]) bottle of soda to be passed down through generations (like a fine wine) for 1000 years (ref [4])? Of course not!



Well, the earth has seen a lot of devastation from the Chicxulub Asteroid @ 65M years ago (ref [5]) that killed the dinosaurs to a Snowball Earth @ >650M years ago (ref [6]) due partially to “ice-albedo feedback”. The earth will hang in there, regardless. As we orbit the sun, the question is: “Can we deal with the plastic waste in our environment as a **quality-of-life** issue?” Let’s remember, our YOLO descendants probably have to live in our plastic waste for the next 40 generations.

The Ol’ Tin Can

Remember the humble tin can. The can is not completely made of tin, but of steel coated with tin. Nevertheless, tin was found to impede the rust of the iron in steel early on, and the tin canning process was invented in 1810 (ref [7]). Both Iron (Fe) & Tin (Sn) are somewhat common in the earth’s crust (see below). The Sn & Fe terrestrial compounds have been within the earth’s environment long before the existence of humans.

Metals Made the Age

Both the metals Fe & Sn have importance in the history of ancient human society. Ancient Sn deposits were mixed with copper (Cu) to make the superior bronze, hence the Bronze Age @ 3300 BC (ref [8]). Swords were made from bronze; every block of the Egyptian Pyramids in 2300 BC was chiseled using bronze chisels (ref [9]). Iron came later with the achievement of higher temperatures by the use of bellows & forced air to permit iron working, hence the Iron Age @ 1200 BC (ref [10]). Many tools that were made with bronze were replaced by blacksmiths using iron with superior results.

Antiquity Epochs	
Age of Discovery	time frame – years (Before Common Era)
stone age	before 3300 BC
bronze age	3300 – 1200 BC
iron age	1200 – 550 BC
modern age	after 550 BC

The 7 Metals of Antiquity

Including Cu, Sn & Fe, seven metals were known to the ancients (refs [11] & [12]). The metals were copper & lead discovered during the Stone Age; silver, tin & gold found during the Bronze Age; lastly iron & mercury near the start of the Iron Age (ref [13]).

7 Metals of Antiquity						
name	sym	crust rank	melting (°C)	melting (°F)	year of discovery	extraction method
Iron	Fe	4 th	1538°	2800°	2000 BC	meteoric - burn w/charcoal
Copper	Cu	26 th	1084°	1984°	8000 BC	roast & burn w/charcoal
Lead	Pb	37 th	327°	621°	4000 BC	roast & burn w/charcoal
Tin	Sn	49 th	232°	449°	3000 BC	burn w/charcoal
Silver	Ag	65 th	962°	1763°	3000 BC	metallic
Mercury	Hg	66 th	-39°	-38°	1500 BC	heating
Gold	Au	72 nd	1064°	1947°	2500 BC	metallic
Additional Modern Useful Elements						
Silicon	Si	2 nd	1414°	2577°	1824	isolate (Sweden)
Aluminum	Al	3 rd	660°	1221°	1825	electrolyze (Denmark)
Titanium	Ti	9 th	1668°	3034°	1791	smelt (United Kingdom)
Zinc	Zn	24 th	420°	787°	1500	roast (Germany)

These metals were used throughout Europe & the Mid-East within the metals' corresponding time periods.

Meteoric Fe, silver (Ag) & gold (Au) (ref [14]) were significantly different in their metallic forms that they were noticed on the ground as humankind first explored the earth. Heating of mercury (Hg) containing ore caused this liquid metal to flow out. Other metal ores had to be cooked and / or burned with charcoal. The charcoal removed oxides & other impurities. With no scientific knowledge of metallurgy, extraction methods were discovered through trial-and-error & passed down through generations. Most importantly, the earth has encountered these seven ancient metal deposits before & should accommodate their compounds as they are returned as waste, for the most part.

Aluminum

From the previous table, Aluminum (Al) is a very common (3rd ranked) element in the earth's crust. Unfortunately, Al forms extremely strong bond in oxides within its stable form in the earth's crust & never occurs naturally as a metallic (ref [15]). Natural Al deposits requires large amounts of electricity to break the Oxygen bonds to produce a usable metal. Fortunately, Al "is one of the most valuable recyclable materials because there is no limit to how many times it can be recycled" (ref [16]). "Recycling aluminum is the most energy efficient" of the consumer materials recycled (ref [17]).

Silicon

Glass & pottery are produced primarily from Silicon (Si), the 2nd most common element in earth's crust (ref [18]). While Si forms strong chemical bonds in silicates, Si is seldom used purified. The silicates are the most useful. Pottery was used extensively by our earliest ancestors of archaeology. "Humans began making pottery items in East Africa, and both China and Japan as early as 14000 BC" (ref [19]). Around 1500 BC, the 1st glass containers were made in Egypt & Mesopotamia (ref [17]).

Forming pottery & glass requires relatively low kiln temperatures. "Glass is infinitely recyclable without loss in quality" (ref [20]). "The energy saved from recycling 1 glass bottle can light a fluorescent bulb for 20 hours." However, a penalty exists for glass & pottery in transportation costs due to their weight. If glass is hauled significant distances for recycling using fossil fuels, "those roads to Hell on Earth are paved with good intentions!" We must remember that glass is one of the least efficient materials to recycle.

Bronze vs Brass

In the Bronze Age, the ancients mixed Cu & Sn to make bronze which held an edge on swords & was more durable than the more malleable copper alone. Today, brass made from copper & zinc (Zn), is at times, the preferred alloy over bronze where more ductility is required (ref [21]). Cu alloys vary with application; to carry electrical current, Cu wires should be as pure as possible. On the other hand, marine propellers are made from bronze because of the seawater corrosion properties of Zn in brass.

Consumer Choices for Containers

Global Warming is upon us! From now forward, as consumers, we should start buying smart. Global capitalism has certainly shown if we are willing to buy **anything**, the markets will strive to sell us that product regardless.

Choose earth-friendly containers! Buy aluminum cans of soda over #1 plastic PETE bottles whenever possible. The same containers our past ancestors used sometimes point to the ones we should use today. Purchase containers made of glass, pottery,

aluminum, or tin cans over plastic. As a plus, these materials **all sink** in water. Try to eliminate plastic containers from your re-cycling bin!

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