Off Grid Living
January 2015

PYROMANIACS
Fire Throughout the Ages

BACK TO BASICS EATING
What our Ancestors Can Teach Us About Food

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Pyromaniacs: *Fire throughout the ages*

Photo Journal

A collection of primitive dwellings

Food & Gardening

Back to Basics Food: *What our ancestors can teach us about food*

Survival & Prepping

Dawn of Technology: *Weapons & survival tools of early man*
As far back as 400,000 and possibly even 1.9 million years ago, a group of humans discovered a way to apply sparking rocks to dry woody shrubs and change the fate of their species forever. Homo erectus to Albert Einstein was a long time coming, but if it wasn’t for their spark of insight that cast darkness into light, cold into hot, and raw into cooked, there probably wouldn’t be any thinking primates around today to give a damn about the relationship between mass and energy. But those ancient ancestors lit the fuse that would send us into an explosion of biological and technological evolution. Slow at first, cooking increased the caloric content of food, allowing for the development of a bigger brain and also reducing the time spent on eating. Humans spend a tenth of the time eating than our primate cousins, giving us more time for everything else. Fire also lit up the night, scaring away predators and creating a “night life” of social gathering. Fire ignited our imaginations and fueled our mythologies. We literally became a species of pyromaniacs and we’ve been burning the world ever since.
Admit it, when you were a kid around the campfire, you stuck just about anything you could find that didn’t fight back into that flame to see what would happen. Would it burn? Did it pop, sizzle, change colors? Fire drew your curiosity more than anything else, and that is probably a trait that we’ve all inherited from the first masters of the flame. We applied fire to different materials to see what burned the brightest, the hottest, and sometimes discovered that certain stuff melted and took the shape of whatever crevice or pit it seeped into. How much of what we take for granted - metallurgy, art, technology - came from curious apes sticking random things into the cooking fire? Some of the gooey clay earth they dug for their fire pit hardened from the heat. How long after that did pottery become a thing? Take a moment and look around you at all the piles of stuff that are the trademark of a technological society and ask yourself where fire plays a part. The device you’re reading this on still, for the most part, derives its electricity from a fire somewhere, or else it was printed by a device that gets its power from the same.

Though, what is fire, really? Whence comes the flame?

Fire is, technically, an exothermic chemical reaction also called combustion, and a flame is the effect of that reaction. I know, boring right? But it gets more interesting from here. Let’s take the kind of fire you are probably most familiar with: you take a log of wood, strike a match, hold the match to the log for a period of time, the log catches fire, and you grab the marshmallows. But here’s a question to ponder: is the log actually on fire? Does the flame come out of the log? “Of course
it does!” You might say if you didn’t already suspect that this is a trick question, but the answer is way more fascinating than that! What you did with your match was heat up the wood. At about 300 degrees fahrenheit, the cellulose in the wood broke down and evaporated into volatile gases otherwise known as smoke. Now, if things didn’t get any hotter, you would’ve just ended up with a bunch of char, smoke and ash, but as you kept your match steady, the smoke heated up to about 500 degrees fahrenheit and things really started to get interesting. The smoke broke down into its constituent elements of carbon, hydrogen and oxygen. These excited elements then recombined into water, carbon dioxide, etc and these reactions in turn generated more heat in a cascading chain reaction. Viola! Fire! This extra heat evaporated more smoke from the wood, which in turn broke down and re-combined to generate more heat. So, in effect, you quickly decomposed and evaporated the wood, and actually ignited the resultant gas. As the carbon and other atoms in this reaction got hotter, their electrons emitted photons at varying wavelengths depending on how hot and excited they were. This you saw as a flame.

The shape of the flame is a result of gravity and convection. Hotter gases are less dense than colder gases and so rise as gravity pulls the colder, denser gases down, creating a tear drop effect. Without gravity, the flame would form a sphere, and quickly go out as the combusted carbon dioxide and soot stick around preventing oxygen from getting in to join the fun (see the image below).

Let’s take a look at the stuff we’ve burned, and how we still burn it today and see how far we’ve come. In this article we’ll start with the hard stuff, biomass.

Part 1: BioMass

Our early experience with energy involved mostly solid fuels such as wood and woody plants. Wood is a great, low-tech fuel source because it’s everywhere, it’s stable, and it’s renewable. Our ancestors probably relied on dead and fallen branches and shrubs. For most of our culinary history, wood has been the fuel of choice, with some exceptions, because it burns hot enough over a large enough surface area to heat our foods thoroughly. We even use different kinds of wood to achieve different flavors in our cooking. Our fascination with a burning log in the hearth on a cold wintry day is so ingrained in our collective psyche that we have invented fake electric fireplaces that create a high-tech illusion of a very low-tech pastime. Wood
is and probably will be the iconic symbol of our use of fire for unknown years to come.

The basic unit of wood burning is, of course, the log, often split into billets for finer control of burning. In order to keep the fire burning, you had to add another billet or log onto the fire or into the furnace. Nowadays, we’ve turned the art of wood-burning into a science. In the spirit of efficiency and reducing biomass waste products, the 20th century saw the introduction of the pellet stove. A pellet stove burns small pellets of compressed sawdust and wood. The smallish nature of the wood pellets allows for efficient temperature control by metering the amount of pellets that are fed into the fire. For cooking, wood pellet grills and smokers allow for easy temperature control and great flavoring of grilled and smoked meats. Any form of cellulose that you can compress into a pellet using a pellet mill can be used as a fuel source. There are many sources for home pellet mill systems. For an off grid project, wood waste, weeds, grass, and the unused portions of food crops can be compressed into biomass pellets for cooking and heating. Most pellet stoves run on electricity, but WiseWay Pellet Stoves sells a non-electric model.

Another approach to creating biomass fuel out of paper waste or dry leafy shrubs and grass is to process and press the material into uniform briquettes for easy use in any biomass furnace or stove. If you find yourself with excess newspaper, junk mail, cardboard boxes, lawn clippings, fall leaves, or even those crazy pamphlets left on your door by a local cult or satellite TV salesman, then you have a source of biomass that you can turn into fuel briquettes. Whether you keep them handy in your bug-out-bag for when the black helicopters come to take away your toothbrush, or if you plan to use them on your next campout, making biomass briquettes are a good way to be prepared while re-using waste. Biomass briquettes can be as simple as pulped paper slurry pressed into briquettes by a rigged caulk gun, or, if you’re mainly using plant material and leaves, you can smoke the material to create charcoal and a special press to create charcoal biomass briquettes.
Lawn and garden clippings that end up at the landfill simply decay, releasing CO2 and methane into the atmosphere. Converting this material into briquettes delays this eventuality and provides energy when you need it. If you parcel out your off grid garden with a special section for hemp or alfalfa or any other grass, and then process this crop into biomass briquettes, you have created a carbon neutral energy source by only releasing the amount of carbon into the atmosphere that you at first sequestered. Growing alfalfa can work as both feedstock and an energy crop, and you can collect the processed alfalfa from the other end of the animal for burning as well. It’s like killing two birds with one turd.

Biomass crops could be a $20 billion boon to the agriculture industry, and if you wanted to make a little extra dough off the grid, growing fuel isn’t such a bad gig. Firewood sales still brings a moderate paycheck, but replac-
Above: a pellet smoker/grill
Below: a pellet mill that can be used to compress biomass materials into pellets
ing those trees takes years and the carbon uptake to release cycle doesn't help our atmospheric carbon situation. Growing and producing fast growing biomass and compressing it into log sized briquettes has the same practical purpose as firewood, but without the splinters. And, if folks need to feel like they're burning actual logs, make your press mold look like a dang log! In a society that's willing to buy digital fireplaces and where the fireplace channel is not only a thing, but very popular with over a dozen offerings on Netflix, Comcast, Amazon Prime, Roku and more (That's almost as many channels as ESPN!), it shouldn't be hard to sell a fake yule-log made of alfalfa.

If you don't want to go through the hassle of turning your woody or paper waste into pellets, there's always the rocket stove which is a bottom loading biomass burner that burns hot and virtually smokeless. BioLite sells a thermoelectric model that charges an on-board battery pack for low-voltage devices. Building your own rocket stove isn't complicated and can be relatively cheap. Something like a rocket stove can be used to burn any kind of biomass such as dung.

Above: charcoal briquette made from coconut shells

Below: rocket stoves that can be used to burn any type of biomass
Dung is used as an efficient, inexpensive fuel source in areas where wood is not readily available.

If you've got animals, then you've got poop. If you've ever taken Metamucil, then you know that cellulose runs right through you, and the same can be said for grass-fed animals. They might get a little more out of it, but what's left is a steaming pile of woody fibers that is flammable. Dung makes an excellent fuel source and is often used in the developing world where wood is expensive or scarce. We even have evidence that our neolithic ancestors used the feces of herbivores as a fuel source, so the next time the local neighborhood prankster leaves a burning bag of dog crap on your doorstep, shed a tear of nostalgia for an era when that was what we had to do to survive. The idea here is to dry the feces into easily manageable chunks called dung cakes. These cakes can then be used in furnaces to heat homes, cook food, and even generate electricity.

Other than burning recently dead wood, or cellulose that's been through the digestive tract of a goat, you can also burn plant material that's been sitting around in wet mires for thousands of years. We've been burning peat for a very long time, and even today a large portion of European electricity and heating relies on peat as a fuel source. Peat is the deposit of dead plant material that has been in wetlands for at least a thousand years. It first needs to be dried, but then it can be pressed and formed into useful logs for use in the home, outdoors, or in industry. The Scots use peat to smoke barley grains that go into making whiskey,
giving it an important pungent flavor known as the peatiness of a whiskey. However, peat is considered a slow-renewable resource, meaning if we use it too fast, it'll be gone before more can regenerate. So, to preserve this resource, we need to find more renewable biomass materials, for peat's sake!

If a peat bog is left alone for a few more millennia, buried, heated, compressed by more layers of soil, and then dug up by aliens in the distant future, it will have become a precursor to coal called lignite. Lignite is a lower grade “brown” coal that burns at a lower temperature than coal. However, if the lignite is heated, thus removing any remaining moisture, it burns just as well as coal and so is mined today as a fuel source. Coal of course is a very popular fuel source and essentially powered the industrial revolution. It's a bit dirty though, and you don't want to cook with it, but there is a coal like substance you can make that doesn't take millions of years. I mean, who has that kind of time these days?

Charcoal is made from wood by heating it in a low oxygen environment to the point of smoking but not combustion. When the volatile smoke is released, what is left is the char, which is nearly pure carbon, and the unburnable ash. Charcoal burns hot and slow making it ideal for cooking and metallurgy. Lump charcoal is the actual wood chunks that are turned into charcoal and those little pillowy briquettes you get for an easy barbecue are made from compressed sawdust and wood waste. Making your own charcoal takes some skill, as you need to keep as much oxygen out of the process as possible. Some methods use a clamp with a small chimney buried in soil and others use a metal charcoal cooker. The Japanese have several specific types of charcoal such as Binchotan, also known as white charcoal, and is favored for it's lower temperature, longer burn time and low smoke production for more subtle dishes on the Japanese menu. In whatever
Two ways to make charcoal: a charcoal burner (above) and a charcoal clamp (below)
form it takes, charcoal is a stable fuel source that is resistant to rot and that will burn longer for better cooking and heating with a minimum of smoke and soot.

It's pretty obvious that if there's one thing that Homo pyromanius knows how to do, it's set things on fire. We've been burning everything in sight for millennia, and it doesn't look like we're slowing down. When we reach Mars and create the ultimate off-grid community, our scientists will be hard at work figuring out how to light the first campfire. It might use a magnesium log ignited by a laser inside a block of dry ice, but you can be sure it will burn. After all, it gets cold on Mars, almost as cold as Wisconsin, and we'll need a hunk of burning biomass to keep us warm at night. After all, Mars could do with a bit more greenhouse gas, there's just this little problem of missing oxygen.

But we didn't just stop at burning solids. There are at least two other states of matter that we eventually started setting on fire, and those will be the subjects of the next two articles. In the liquid part of our series, we'll talk about all the fun gooey wet stuff we sucked out of the Earth and set on fire, along with more sustainable oils and fuels that don't take millions of years to process, and that might even come out of our waste! When we move on to gases, we'll discuss the obvious culprits, but also look at gas as energy storage and how you can use this concept off the grid as a substitute for toxic batteries with short life spans. Then, when we're done setting things on fire, we'll discuss energy from wind and water, electrochemical energy, fission, fusion, and finally, the ultimate energy source for our solar system, that great big beautiful ball of fusion in the sky, our Sun.

Japanese Binchotan - a slow burning charcoal often used for cooking
Back to Basics Food

What our ancestors can teach us about eating

by Shannon Oyler, sustainablesimplicity.com

We live in a very cluttered and complicated world when it comes to one of the most important pillars of our survival: the food we eat. Sure, we have an abundance of choices, and that has many benefits in our busy lives. But is it all good? Advancements in technology and agriculture have made getting and preparing food so simple, many people don’t give any thought to where their food is coming from or the processes it endures before reaching their dinner plate. Most of us have an abundance of food available just a short walk or drive to a store or to the nearest fast food joint. Supermarket shelves are lined with just about every type of food one could possibly hope to find. Convenience has become key over the last several decades. We don’t have to hike for miles and spend the majority of our day scrounging for food as our ancestors did. Most of
Back to Basics Food

us will never have to suffer through the cold winters worrying about how we are going to keep our family members from starving. Of course, there are still many people around the world without access to food choices who face these problems. But for the majority of us, a quick, hot meal is as simple as walking to the kitchen and popping a frozen, prepackaged meal that we purchased at a nearby grocery store into the microwave.

In the midst of all this abundance, however, people are becoming more aware of how our modern food system may not be such a great thing. When you consider how drastically our methods of obtaining and preparing food have changed over just the last 100 years, a very short blip in the history of human evolution, it can be argued that our bodies are not designed to be eating the way we are. You’ve likely seen the hype and movements that have been gaining popularity over recent years: whole foods, organic foods, raw foods, clean eating, the paleo/primal diet, anti-GMO campaigns…and the list goes on. To get a taste of reality, watch just a few of the many food documentaries out there that give a gut-twisting view inside the barns where the chickens for your favorite brand of chicken nuggets are raised or the abhorrent conditions in which most commercial cattle and pigs are forced to reside. And then there’s the genetically modified fruits and vegetables lining store shelves that are often laden with unregulated chemicals from fertilizers and pesticides. And what about all those preservatives, fillers, and mile-long lists of who-knows-what ingredients in packaged foods? Do we really understand the full impact these foods are having on our health and our planet? Perhaps not, but research is leaning strongly toward a huge detrimental impact...
on both. Many believe this system is just not sustainable and that all our “fake” and modified foods are causing a plethora of health problems that did not exist centuries ago. Cancers, diabetes, and obesity have become an epidemic in recent history, and it’s hard to disagree with the idea that this is correlated to our food.

Most people know that eating the purest, healthiest, and safest foods we can obtain is best for our health, but how do we know exactly what types of foods we should be eating? What are we genetically programmed to consume for maximum health? This remains in debate among many nutrition experts. Some believe a meat-free diet is the most beneficial, while others believe only lean white meats should be consumed. Still others believe that humans are genetically programmed to consume an abundance of lean red and white meats as long they are balanced with plenty

Australopithecus afarensis
of vegetables and fruits. Many shy away from dairy altogether, though some claim dairy products in moderation are important. Some believe humans are not designed to eat wheat and other grains, while others argue these are a healthy necessity in our diet. What almost all experts agree on is the fact that our modern diets contain way too much sugar and the simple carbohydrates found in unnatural, processed foods such as refined white sugar and flour. Products like cakes, candy, syrups, cookies, and pastas and bread made from processed flour are not “real” foods and do not contain the nutrients we need for maximum vitality. The schools of thought on the ideal modern human diet are as vast as our food choices. To begin understanding them, we can go back in human history - way back, long before the agriculture revolution began - and see what our early ancestors ate and how that diet changed throughout the ages.

The rise of agriculture and domestication of food animals began about 10,000 years ago. But long before that, up to about 3.5 million years ago, the earliest humans likely ate a chimp-like diet consisting of plants and fruits from herbs, trees, and shrubs. Around 3.5 million years ago, hominid species such as *Australopithecus afarensis*, a small primate thought to be a direct ancestor or close relative to ancestors of modern humans, began to diverge from apes and consume grasses and succulents in addition to their traditional diet. And at some point in this time period, they began incorporating meat into their diets as well. This is evident in the study of the chemical components of teeth in the fossils of these creatures. Evidence of meat consumption can also be found on animal bones from the same time period. The bones show notches and cuts where hominids used tools to remove meat and extract bone marrow. The first meat-eating hominids were most likely scavengers as opposed to hunters, but that changed with advancements in tools and weapons.

The diets of these early hunter-gatherers varied wide-
If you have the resources, you can raise your own livestock and have total control of what they consume, what medications they are given, and their living conditions.
ly depending on the environment in which they lived. Those in warmer climates depended on fruit more than those in colder climates, while those in colder climates likely depended more on grasses and nuts or seeds for sustenance. Regardless of what part of the globe they inhabited, early humans had universal dietary characteristics: they hunted and scavenged meat, caught fish, and ate roots and other plants found in their environment. They did not consume milk (after they were weaned from their mothers, of course) or other dairy products as we do today. They also did not consume grains other than nutritionally-rich varieties they might have found growing wild. And what little “sweets” were available to them were in natural form, such as honey and fruits. Nothing was processed or refined. The only modification to food was in cooking or drying. Everything they ate was clean, natural, whole, and organic in every sense of the modern terms.

Research indicates that people in hunter-gatherer societies were generally healthy and not afflicted with the chronic diseases we see so often in our modern culture, such as obesity, heart disease, high blood pressure, diabetes, and tooth decay. Naturally, life was not easy for these people. They did not have their cozy homes with food in the fridge, water on tap, central heat and cooling, or automobiles for travel. They couldn’t run to the store and buy a package of meat when their food supply ran low. They spent their lives searching for food and creating shelters, tools, and weapons to ensure their survival. Injuries, childbirth, and environmental exposure were the biggest threats of the time, where diseases are the biggest killers in modern humans.

Applying the diet of these early people to modern day eating is tricky, especially when you read through research on the various opinions of nutritional experts. Is milk unnecessary? Should we be eating more healthy fats rather than trying to eliminate fats? Is bread the devil? Deciding what to eat will come down largely to common sense and preference, and I think simplicity and balance are key. Food should not be as complicated as it has become. If what you’re eating is processed, bleached, refined, was built in a factory, or

Wild game is a healthy source of red meat
has an ingredient list ten miles long, it’s probably not a great thing to put in your mouth. If it’s loaded with enough preservatives to reside on your pantry shelf for the next couple decades or sit in the hot sun for days without spoiling, it’s likely not real food. I tend to follow the paleo/primal school of thought when it comes to eating: plenty of healthy meats and vegetables, some fruits, and seeds and nuts. That doesn’t mean I don’t occasionally binge on sugar cookies or dump heavy cream into my coffee in the morning, but for the most part, I stick to this way of eating and it agrees with me. But it may not be ideal for everyone. What makes the most sense for your lifestyle? Do you have certain health conditions that make a particular diet work better than others?

**Taking control of your food**

Whatever school of thought you follow pertaining to the types of food humans should be consuming, you most likely are wanting to ensure that you are consuming a healthy, sustainable range of food choices. The only way to do this is to take complete control of your food. Knowing where it comes from, how it was made or grown, and what ingredients were used are essential. No matter your living situation, you have a variety options for getting the best quality, nutritionally rich foods.

**Grow your own food.** Even a backyard garden, if planned properly, can produce enough food to easily feed a family during the growing season and provide plenty of food throughout the year if you preserve some of it and grow foods that can store for long periods. There are food growing options for just about every living situation. If you live an apartment with a balcony, you can grow several fruit and vegetable varieties in pots. If you don’t have any outdoor growing space, you can grow herbs and some vegetables in a sunny windowsill or try some of the many cool indoor hydroponic or aquaponic grow systems. Even very small grow systems can be quite productive. I live in town and have an averaged-sized yard, but am able to grow a garden in my back yard large enough to easily feed myself and my kids with loads to spare for giving away to others. I have also used a few different types of indoor hydroponic systems, including an AeroGarden that has grown surprisingly large and productive countertop herb and salsa gardens.

Why grow lawns when you can grow a garden? Even an urban back yard can grow an abundance of food. Here’s a glimpse of how my yard looks in the summer - lots of food and no grass to mow!
Farmers markets are a great place to buy local, healthy, organic foods.
Raise your own livestock, if you can. So many commercial meat animals these days are pumped full of antibiotics and hormones and fed unnatural diets to maximize their milk, meat, and egg production. Many are even genetically modified to grow larger and faster. Having control over what your meat animals consume is priceless. If you can have a few beef cattle, a milk cow, or even just a small flock of chickens, you can ensure they are eating a natural, free range diet and control what medications, if any, they are given. Not only will this ensure you and your family are getting the best quality meat and eggs, but can become an income source if you have enough to sell to others.

Hunt and fish for your meat if you don’t live on land where you can raise livestock. A freezer full of elk or venison is a super healthy meat source and will save you a lot of money if you live in areas where hunting is close and convenient. There’s not a much better way to get back to eating like our ancestors than by making wild meat a staple of your diet. Game meats can also be purchased from meat processors and some stores if you want to eat game meat but don’t hunt. Just be mindful of how the meat was processed and preserved.

Shop local. Does growing, raising, and hunting your own food not fit your lifestyle? You can still eat sustainably and healthy by finding local organic food growers to purchase from. Organic farms are gaining popularity and can be found in many areas as a source for clean produce and free range livestock for meat and eggs. And you’ll be helping support your local small farmers - a big plus! Many areas also have natural food co-ops where food from nearby farms can be purchased. Most of these co-ops are careful to buy as much local, organic food as possible.

Shop smart. If none of the above are viable options and you need to purchase your food at the store, you can still find good options at large supermarkets. Read labels and look for certified organic produce. Be wary of anything labeled as “natural”, because that term is widely used and can be slapped on the label of just about anything. Finding quality meat and eggs can be more of a challenge, as the USDA does not regulate how animals are raised when “free-range” or “pasture-raised” is used on the label. Many egg manufacturers may also use terms like “cage-free” on their packages. Cage free could easily mean that chickens are raised in a barn, not in cages, but they still might have no access to the outdoors and may be stuffed literally on top of one another in the barn. If possible, obtain your meat and eggs from local, reputable food growers.

Most experts agree that diet is 80% of the healthy body equation, but exercise is also important, and that is another huge difference between us and our ancestors. While our early cousins spent the majority of their lives wandering, hunting, and foraging for food and shelter, we tend to spend the majority of our lives inactive. Our daily quest for food might be no more intense than walking from our couches to our kitchens. For optimal health, both a healthy diet and exercise need to be implemented (I know, you’ve heard it a million times, right?). Planting a garden may not give you quite the exercise that was involved in wandering over tough terrain to collect food as our ancestors did, but it is certainly more intensive than walking down the aisle of a grocery store (and much more rewarding!). And hunting is almost always great exercise, as long as you’re not one of those people that shoots animals out your truck window. Hike for miles to bag a deer and drag it out of the wilderness and you’ll feel great about the effort, despite your screaming muscles.

Whether you choose to kill and drag home your own meat or shop smartly at your local store, sustainable and healthy options are available. The choice is yours.
Today we are surrounded by technology, from the alarm clock that wakes us up and the pre-packaged meals we eat to the cars we drive to and from work and the grocery store. We have gizmos and gadgets for entertainment and communication, tools for creating and destruction, and weapons from knives to atomic bombs. Most of us never leave the pavement and our only exposure to nature is to and from the car, a day at the park, or a trail hike. Those of us that camp take our technologies with us. We take filtered water, canned food, dehydrated food, sleeping bags, campers and fancy tents. What was life for humans like before we had all these luxuries and conveniences? How many of us today could survive without them? How did we advance from gatherers to hunters and learn to clothe and feed ourselves with nothing but our intelligence and imaginations?

Gatherers & hunters/scavengers

Humans are amazing creatures; we can excel in areas that other organisms cannot. Just look at Olympic athletes and the balance, strength, and coordination they display in their sports. But compared to other species we are unimpressive hunters without our tools. We are slow runners with no teeth or claws suited to kill. Before we had the skills and knowledge to manufacture the tools that allowed us to hunt, we were restricted simply to gathering. As evidenced by findings in the
Burin and scrapers - tools created and used by early humans
earliest preserved dwellings of man and our close cousins, we lived on fruits, nuts, insects, seeds, and shellfish. Insects are more nutritious than the meats we eat today, but somewhere along the line we lost the appetite for squirmy nasty bugs. The most advanced tools used by these peoples were likely stick clubs and sharpened digging sticks. We also used stones to crush nuts and seeds to get at the nutritional contents.

Our early ancestors were fragile and easy prey for large cats and other predators. We may not have been strong, but we had several other advantages that other species did not, mainly our intelligence and our ability to out-smart them. Evidence from bones that show cat tooth marks alongside scratches from human stone tools indicates that we stole meat from large predators. These bones were scavenged from a leopard that may have left the carcass unattended in a tree. We did not have the teeth or the strength to break the bones to get at the marrow like other predators. Instead we developed tools. Stone tools go back in the record more than 2.5 million years! Pebble tools were simply rounded river stones that were impacted with another to produce a sharp edge on the fracture. Some of the pebbles were used as tools to crush bones and get at the marrow, while the sharp flakes were used to cut meat from the bones. These tools were very crude and were not refined in any way. No secondary or shaping flakes were
used like on more modern advanced projectile points.

A simple experiment demonstrates a chimpanzee being shown how to produce flake tools and given a box of food bound with rope, then given a flint nodule and a hammer stone. In short order the chimps could knock off a sharp edge flake tool and saw through the ropes to get to the food inside. These early tools did not require a high I.Q. to figure out. This went on for hundreds of thousands of years until the tools became more refined. Early man began to shape the pebble tools into more advanced hand axes. The flake tools were chipped on both sides and flaked to re-sharpen the edges and straightened into points and other useful tools.

Primates have one other advantage that other species do not utilize: thermoregulation, or the ability to sweat. This is used to this day by African aborigines that have the ability to keep cool while running long distances. Three or four hunters with sharpened sticks can run down a large animal that can escape even lions. Lions overheat on the hot savannas and have to stop to pant and cool down. The prey simply has to outrun them in short bursts until the lion overheats. Men can keep going, running down the antelope or deer until the animal is paralyzed with heat exhaustion and can run no further. All they have to do is stick a sharpened stick
through the vitals and the game goes down. This thermoregulation advantage allowed humans to drag their kills back to a shelter in the scorching afternoon heat that keeps most large predators panting in the shade waiting for cooler evening and night time temperatures. Humans had safety in numbers and, in some cases, fire to ward off hyenas and other animals that wanted in on the kill.

Once a large carcass was at hand, the real learning began for our ancestors. They used flake tools to scratch deep grooves in the bones then hammer stones to extract the bone marrow. They cut strips of meat and realized that they dried to a jerky and could be preserved for later. Long strips of silvery shiny sinew along the back of animals could be dried into bands that easily stripped into strong strands that could be used as thread, string and corded into longer cordage. When soaked in the mouth the threads become soft and could stretch out. If the end was left hard it became a built in needle for sewing. When the sinew was wet and pliable, it was used to wrap stone and bone points, then allowed to dry where it shrank down tightly and held them in place. Larger bundles of sinew in tendons could also be pounded to break into threads.

Pockets of fat left on the animal hide softened the area they were attached to and left the hide pliable, where it stiffened up in areas not saturated with melted fat. This lead to applying the fat and later brains over the entire hide and working the hide by pulling and flexing it until it dried in a pliable softened state. This was also refined over the centuries, generation to generation, until the velvety suede-like buckskins of more modern man emerged. It was discovered that smoke from fires prevented the softened hides from stiffening up from rain or sweat. Softened hides and raw hides were excellent materials for making containers. The Native American parfleche is a good example of how rawhide could be folded and tied to encase tools, store food, and transport items. Softened hides could be sewn together using plant fibers (and later sinew) and fashioned into clothing for protection from the sun and weather.

Early humans discovered that the shattered bones that marrow was extracted from had sharp edges and points. Using a flake blade these could be scraped and ground to further refine the points. Soaking them in water made them easier to work. Bone points were easy to produce and were easier than stone points to manufacture. Flake tools were refined into burins and drills. These could be used to aid in production of various other tools. To make a needle, for example, a bone would be soaked until soft, then a chisel edged corner of a flake blade burin was used to scrape parallel lines in the bone down to the marrow. Then it would be struck with a hammer stone to free the bone splinter. While still soft from soaking, a chipped stone drill bit would quickly drill from opposite sides of the splinter to meet in the middle to produce a hole for a thread. Then the splinter would be dried and rubbed on a piece of sand stone to grind it to a point and shape it into a polished needle. Broken shin bones were ground flat and grooves were cut into the edge to produce the fleshing tools used to scrape the fat and meat off the inside of hides. Flake blades were chipped away from the flat side to produce stone scraper blades used to remove the hair, hypodermis, and epidermis layers of the hide, leaving the easier to
work dermis layer.

The antler had properties that allowed better control of flaking stone than bone, wood, or other rocks. Antler is dense and hard, yet soft enough for it to stick to the edge of the stone being impacted for a split second and transfer in more energy for a longer flake blade. Glue was discovered in tree sap and used to set stone points in the shafts of antlers. This was later refined by adding charcoal to the sap to give it strength. Another type of glue was discovered by boiling sinew scraps, hide scrapings, and other animal proteins in pottery containers. When the broth cooled down it turned into a jelly like film, then hardened to a jello consistency, then rock hard hide glue that could be hydrated and used with sinew and other items much more securely than sap glue. Sap could be used over these as a water proofing agent.

Other containers were created when humans learned to weave plant fibers and willow shoots into small baskets used for carrying nuts and seeds. Pottery most likely was discovered in the process of smearing clay into these baskets to water proof them for cooking stews in the coals of fires. The clay became rock hard and did not revert to its pliable state by adding water. Basket marks have been discovered in clay shards that have survived the elements to the present day. Pottery, too, was refined generation to generation. Other grasses and animal hair were spun into threads and woven in different patterns to produce materials suitable for clothing, blankets, belts and coverings.

Early man also overcame their fear of fire and took advantage of the heat, light, and protection it offered from predators. Perhaps first obtained from lightning strikes or lava flows, man learned to feed fires and maintain a coal that could be blown into flame when grasses and shredded bark were added. They then could feed these with larger bits of wood until a proper fire was obtained. Later on, perhaps while drilling into wood for another purpose, humans learned that heat was generated by friction and a coal could be pro-
duced this way. With the ability to produce fire and not gather it, they could truly master their environments.

These were all discoveries more than inventions. Our ancestors observed and took advantage of things that happen in nature and tweaked them to their advantage. Generation after generation these skills were taught and refined. With decent weapons and fire they were able to become true hunters and had the ability to travel in the open and migrate. They learned techniques of hunting larger and larger game. They took advantage of weaknesses observed in other species and used them to their advantage. Herds could be spooked and stampeded over cliffs using grass fires and by waving branches and hides. Huge quantities of meat and raw materials became available this way, allowing larger and larger populations to thrive.

Mammoth hunters

Mammoths and modern elephants have large, flat bottomed feet that allow them to sense vibrations in the ground generated by ultra-low sound waves other elephants produce that humans cannot hear. Elephants can sense these for up to two miles. This is an advantage for elephant communication, but is an extreme disadvantage in muddy terrain with depressions. Elephants can become trapped in shallow depressions where mud keeps them from getting a foothold. In Hot Springs, South Dakota, just South of Mt. Rushmore, there is an ancient natural elephant trap. Millions of years ago the area was
covered in a shallow sea. A huge layer of limestone was laid down, then over millions of years plate tectonics pushed the continents to higher and higher altitudes forming the Rocky Mountains and laying down layers of soil and rock over the limestone in the Black Hills. A natural spring washed away the limestone, causing a sink hole. The sink hole, fed by the spring, became an oasis for plant life not seen on the surrounding plains. Elephants are matriarchal and the males are rejected from the herd. These lone males would travel into the pits to get at the vegetation and became stuck. To date 61 individual mammoths have been identified.

Our ancestors exploited this disadvantage across the globe. Sharpened sticks were laid out in patches near herds of mammoths and they were stampeded over them. The sticks would stab into their sensitive feet, leaving the beasts vulnerable and easy prey to spears and thrown rocks. Humans utilized terrain, chasing herd animals up dried ravines where they were ambushed by hunters waiting at the top. They used natural pens to corner large quantities of game and spear them safely from the raised perimeters. When large game were not available, and perhaps as a supplement, they continued to snare small game and hunt them with throwing sticks and rocks.

The rise of agriculture

As humans advanced further, they began planting seeds from the best plants they harvested and over generations artificially selected and guided plant evolution to their advantage, to the point that almost all of the plants we now buy at the grocery store are as man-made as dog breeds. They also formed an alliance with dogs, forming a symbiotic relationship which provided the dogs with food and shelter, and the humans with companionship, labor, and hunting partners able to sniff out game where humans could not. They captured and penned other animals such as the extinct Oryx which produced modern cows. They domesticated goats, sheep, pigs and several species of birds.

With the ability to feed and defend larger groups of people, early humans had more time on their hands to sit and think. They became artists and began to truly invent things unique to humanity. They explored their

Domestication of the horse changed human history. Horses pulled our plows and carts and carried us into battle.
environments and learned to fashion new tools from new materials. They learned to extract and shape soft metals. Copper was fashioned to make hafted chopping blades and projectile points, as well as artistic items and other tools. Later alloys were discovered and their metal working abilities progressed from generation to generation like primitive skills. Weapons became more advanced than spears with the discovery of the atlatl which allowed a small spear to be thrown many times further than with the arm alone. Slings were used to propel small rocks over longer distances. Metal blades became longer. They learned to heat treat metal to make it stronger and less brittle, while keeping a hard sharp edge. Swords, spears, and clubs were soon to be overshadowed by the most devastating weapon to date: the bow and arrow. The bow and arrow has killed more animals and humans than any other weapon, including firearms, in the history of man. I’ll say that again: more than guns, bombs and nukes combined. Humans refined these from stick weapons to sinew backed, horn bellied, wood core weapons that could cast an arrow hundreds of yards. These were used for centuries to conquer entire continents.

Upon discovering leverage, humans were able to roll large rocks on beds of logs over long distances using ropes twisted from plant fibers. They used these stacked rocks to track the stars and record the seasons, which gave us the ability to produce better crops and feed even greater populations. In several cultures these were used to build great temples, tombs, castles, and defensive walls that stand to this day. The wheel and axle soon followed, allowing them to build small carts and wheel barrows. They then formed another alliance with a species that gave them even greater advantages than the dog: the domesticated horse. Horses were able to pull their carts, plow fields, and transport them into battle.

With humans’ ability to migrate and produce all of these items, we became a warring species fighting for water, raw materials, hunting grounds, and material wealth. Populations raided each other for territory, horses, women, and precious metals. Armies rose up on foot and mounted steed. Populations started drawing imaginary lines on maps, creating borders of territories for cultures, religions, languages and race. Siege weapons were invented to breech and knock down castle walls. Then there was the invention of gun powder, first used for fireworks and then to propel projectiles that were more powerful and accurate than bows and arrows. Since the invention of gun powder we have learned to split the atom. Like all technologies before, this knowledge can be used to survive, kill, create, or destroy.

It remains to be seen whether or not intelligence is a good survival trait. Yes, in the short term it is beneficial, but it can also assure the destruction of our species, and we have already taken countless other species to extinction. From breaking a rock, to splitting the atom, we as a species have become masters of our environments, and the fate of most other organisms rests squarely on our shoulders. Will man endure? Or will yet another species learn to break rocks?