

**Some pages are
incorrectly
numbered**

IQP/MQP SCANNING PROJECT



**George C. Gordon Library
WORCESTER POLYTECHNIC INSTITUTE**

Project Number:46-JMW-SATP

Medieval Technology: An Arms Race

An Interactive Qualifying Project Report

Submitted to the Faculty

Of

Worcester Polytechnic Institute

In Partial Fulfillment of the requirements for the

Degree Bachelor of Science

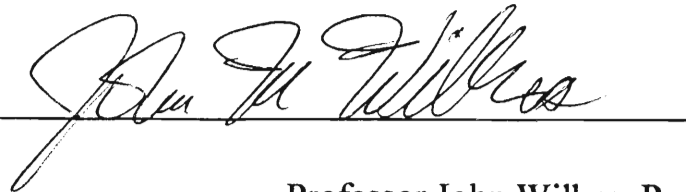
By



Mathew Alphonse Copolla

May 10, 1999

Approved:



Professor John Wilkes, Project Advisor

Abstract and Overview

for the 6th Grade Science, Technology and Society Curriculum Unit

The effort to produce a 6th grade society-technology curriculum unit to precede a trip to Higgins Armory for Worcester students, took one step forward in this project. The precursor projects were deemed too long last year, and a team cut the unit back from 2 months to a week of social studies and science classes, but did not produce final draft. In this project the unit was refined and cleaned up, further shortened and sent out for review by people in science and social studies, in Worcester and other districts, and examined in light of the Mass. state curriculum guideline for science education- particularly strand 4, Science, Technology and Human Affairs. It was still found wanting as it must be in a different format and integrate all 4 science strands- not just focus on the one easiest to connect with social studies. However, these critiques have suggested a strategy that might work to meet all the competing criteria and be of very high quality. Another team will have to take up that challenge, and go to the stage of field testing.

This project builds upon the prior projects of Tom Russell, author of "The Tangled Web of the Bronze Age, Beverly Koch, author of "Medieval Technology" and the team of Paul Proulx and Brian Leary, who worked with the Higgins Armory to draw in this local resource and provide a brief preparation experience for 6th graders who would be visiting the Armory. At one point it was thought that all 6th graders in the city would be doing so each year as a special rate had been negotiated, but that effort was never fully funded with money reserved exclusively for that purpose. A teacher had to take the initiative and ask to be scheduled for such a trip. By mid year few teachers had so the money was released to other purposes. These changes did not seriously impede the current project, since the approvals necessary to proceed to field testing were not received. Another round of revisions will be needed before they will be received and meeting the requirements of both the science and social studies coordinators may not be possible.. A closer working relationship with one of the curriculum coordinators will probably be necessary to reach this milestone next year, and go to field testing.

MEDIEVAL TECHNOLOGY: AN ARMS RACE

TABLE OF CONTENTS

SECTION ONE (Introduction)	1
I. THE HISTORY AND BACKGROUND	2
II. BRONZE BASICS.....	3
III. WHERE, THE GEOGRAPHY	3
IV. TRADE SYSTEM.....	6
TRADE GAME	
SECTION TWO (Science).....	7
V. IRON THE NECESSARY PROGRESSION	7
VI. BRONZE AND IRON COMPARISON OF DIFFICULTY IN THEIR USE: A STUDY IN TEMPERATURE.....	7
VII. THE IRON TO STEEL TRANSITION	8
VIII. THE HAZARDS OF THE CRAFT	12
ALLOY MIXING AND SWORD MAKING	
SECTION THREE (Technology).....	17
IX. ARMS DEVELOPMENT AND THE GROWING NEED FOR ARMOR.....	17
X. THE ARMOR PRODUCT LINE: ARMOR TYPES FOR EVERY OCCASION.....	19
XI. TECHNOLOGICAL ADVANTAGES OF ARMS AND ARMOR	22
ARMS AND DEFENSE GAME	
SECTION FOUR (Social Studies)	26
XII. SOCIAL STRUCTURE: THE CLASSES AND A WORKING HIERARCHY.....	26
XIII. A LAW AT WILL: LEGALITY BASED UPON A LORD'S DISCRETION.....	40
XIV. THE CASTLE	42
SECTION FIVE (Conclusion).....	45
XV. TECHNOLOGICAL ADVANCE: THE INVENTION OF THE GUN ...	45
CLASS DISSCUSSION AND REVIEW	

SECTION ONE (Introduction)

I. THE HISTORY AND BACKGROUND (General Introduction)

The purpose of the first two units is to immerse the students in the economy of the Bronze Age so that they can gain an understanding of the evolution that took place from the Bronze to Iron Age. First, there will be a lesson on bronze and its uses in ancient times as well as a lesson on the government of the time. This should cover the emergence of the Sumerian City states up to the Roman Empire. After one lesson for orientation, an immersion will take place in the form of a role playing game. In this game the students will be broken up into five City States that rely on each other's trade in order to thrive, and perhaps to survive. Each group will supply a different good or service that is needed by all groups, and trade routes will be established between the groups. Differing goals will also need to be met, but at a possible cost to trade. By having the trade routes break down, the students will see the inevitable reason for the shift to iron, as the materials to make bronze become less and less available.

Let's stop for a minute here and catch you up. First, the empires we are talking about ceased to exist over 1000 years ago. For you, that is over 100 times longer than your life, thus far. During these times they didn't have cars or planes; they didn't have telephones; and they didn't have electricity for modern day conveniences like refrigeration or television. All of their travel was done on foot or by boat or horseback (with a cart or wagon). The technology of the Bronze Age was based on wood, rope, and

a few metals. There were no plastics, but there was pottery a form of ceramics made out of clay.

In the times before the medieval era, the period was known as the Bronze Age. This period included many great empires and began a movement of people and hence, civilization, from the regions encompassed by the Nile and Tigris and Euphrates Rivers. The civilization expanded into nearby areas and ultimately as far as the whole of Europe. The Bronze Age was the time of many great civilizations such as those of the Sumerians, the Babylonians, the Assyrians, the Greeks, and the Romans. All of these cultures were based on economies of trade, and most were divided into many states with varying resources. Even those civilizations involving centralized government required trade among different centers of population. It was this scattering of resources and urban locations that led to their trade economies.

So how did these people live and how did they trade goods? Well, for one thing it took them much longer than it takes us now. In the beginning of this time, they didn't usually buy things with money, but they tended to trade for things. This exchange-based economy was called bartering. If you needed food, you might trade metal, tools, or even your labor for it. However, at this time money was evolving as a trade medium; first as a ceramic image of what you could get for it (grain, wood or an animal) or later as a symbol of a god that represented or protected a species or city. Even later as a measurement unit of value by weight. By the end of the period, general exchange mediums in the forms of coins like we still have today had appeared as was reasonably established throughout the area that had been ruled by Rome.

II. BRONZE AGE BASICS

During the Bronze Age people did not have the types of metals that we are so familiar with today. Iron, steel, and aluminum did not exist yet unless they occurred in nature. Basic metal was expensive as well. The people of the Bronze Age used gold, silver, lead, copper, tin, and finally bronze. Copper can be found in the ground naturally as an ore, but bronze is an alloy, meaning that it is made out of more than one type of metal. Bronze, in its best form is made with a small amount of tin and a lot of copper.

Copper is a soft metal that can melt very easily. Tin is a white metal that also melts easily. When these metals are mixed together they make a harder metal than either tin or copper that does not corrode, and therefore bronze is much more useful than either naturally occurring metal. The problem with bronze is that in order to make it, you need both copper and tin. Copper was fairly easy to find during this time (though not everywhere), but it was especially plentiful on the island of Cyprus and in the Sinai desert of Egypt. In contrast, tin could only be found in a few places, mostly mountainous (such as in Syria). For this reason many people had to trade or barter for tin that would be brought in by caravan so that they could make bronze.

III. WHERE, THE GEOGRAPHY

The Bronze Age started in the Sumerian period (about 2800 BC). The Sumerians were the first people to use bronze widely. In fact, they were the pioneers or early users of many things, like an alphabet, a written code of laws, and structured cities. The

Sumerian civilization was built of city-states, each of which had its own governing body. Only Egypt along the Nile was very developed in this period. Copper was the abundant metal, but it was not very strong. The Egyptians had been using copper since around 4800 BC, as there was an abundance of it in the lower Mediterranean and on the island of Cyprus and near Egypt in the Sinai Desert to the east of the Nile. As mentioned, bronze is an alloy of copper and tin. The Egyptians had no tin resources or they probably would have been using bronze for a long time before this. The Mesopotamian area (the land between the Tigris and Euphrates Rivers) had access to a substantial tin resource in the mountains to the east and in the waterways that flowed through these mountains and so bronze first emerged there.

Bronze and copper were the primary metals used in weapons and tools until the Hittites came down from the north and conquered Mesopotamia in 1600 BC. Gold and silver did not make very effective tools, but were prized as decorations. They became “precious metals” due to their favored appearance, but bronze was the metal that was important in terms of use, rather than gold and silver, which signaled wealth. The conquering Hittites were important since they were the first civilization to begin using iron for tools and weapons. They used it in addition to bronze, not as a replacement for bronze as their iron was very crude and liable to break, so as they gained access to bronze they actually used iron less than before.

Around 1100 BC, another bronze based civilization began to use iron, the Greeks. It was around this time that the Bronze Age began to decline. The quality of iron was improving and it was becoming increasingly abundant because it was stronger than bronze; though the rust problem reduced its value. The Roman Empire did use iron but

concentrated mainly on bronze. Rome controlled all of Europe and the Mediterranean. Therefore, they controlled all of the tin and copper sources in the area. The Wales area of England turned out to be another good source of tin. Their bronze use declined rapidly around 400 AD as the “barbarian” invasions and piracy began to cut into the trade routes that supported their bronze-based empire.

From around 500 AD until the beginning of the crusades in 1100, there was no centralized power in Europe. The power that arose at this time was the Church. By this time, iron had become the main metal in the west, as there were few safe trade routes through Europe to distribute the tin needed to make bronze.

Iron processing had greatly improved by this time. It was not much stronger than bronze and the rusting problem could be controlled with oil coatings. The centralized power of the Church and later the development of nation states allowed trade to flourish again more safely and easily, allowing tin to be traded again. Even with trade routes open, iron had become a cheaper and superior metal to bronze for use in tools and weapons. Bronze was still used in many specialized applications, especially in statue making and as fittings for ships. This is because it is not only rust-free, but it is an attractive metal, especially when polished. It would also be used in coins, sometimes in addition to other metals like gold or silver, to make them stronger. However, by then, the “Bronze Age” had clearly given away to the “Iron Age”.

IV. TRADE SYSTEM

The economies of the Sumerians, Greeks, and Romans were built on trade, as all of their weapons and tools were made using bronze. Now you may be thinking that trade is easy, just go next door and borrow some sugar from your neighbor. This wasn't the case back then. Trade routes between states could stretch many miles, sometimes through tough terrain laced with mountains and rivers. The Mediterranean Sea was the major highway being the easiest, cheapest, and most fast method to move bulks of heavy materials (via boats). There were no trucks, railroads, and even wagons were rare. During this time, chariots and all wheeled vehicles were expensive. Few people, only the wealthy, could afford such luxuries. The roads tended to be for foot traffic and bearers carried everything, from members of nobility to sacks of grain. Caravans, or groups of men leading animals (usually horses, camels, or mules), transported heaving trade goods such as metal, grain, cheese, wine, cloth, manufactured items etc. Given the long distance to be traveled, trade was far from a sure thing. At times a caravan would not make it home, the whole group disappeared. Caravans were often robbed by bandits or by hostile states causing the caravan to lose parts of their cargo, which in turn caused the price of the remaining goods to go up. Sometimes caravans were held for ransom or just taxed and tolled for high amounts. (Directive to Teacher: this would be a good time to look at a map and then point to the areas in which the Sumerians, Greeks, and Romans ruled and then indicate probable trade routes).

TRADE ROLE PLAYING

The Play- The class is to be broken up into five groups. Each group is assigned a specialty with which they will trade for the needs that they have. All groups can produce bronze if they have the copper and tin, but not necessarily good bronze. All groups have very basic farm skills in that they can produce a limited amount of grain. Each group has to assign people to produce the goods, people to trade the goods with other states, as well as a leader to oversee all of these affairs. Once trade has commenced, and the trade economy is established, the tin supply will be cut off. .

- 1 bronze production unit makes raw bronze
- 1 bronze production unit make a bronze impliment
- An impliment can be either a weapon or a tool.
- 1 bronze production unit fixes a tool
- Bronze tools have a use life of 5 turns (so 1/5 of your tools will need to be melted down and re-cast per turn)
- 1 tool is needed for every 5 food units
- Only one turn without food is allowed, after that all without food leave the state.

First each state needs to figure out their needs and their surpluses. Once this is determined, each state needs to find a way to fulfill their needs through trade and expansion

Expansion is done through weapons count and dice rolls. In order to conquer another state, you need to attack them when they have no weapons. In order to attack, you both roll dice. Three dice are rolled if you are attacking and two if you are defending. The attacker takes the best two rolls and puts them againse the defense roll. Ties go to the defense, and for each lost die, two weapons are lost. If the attacker has less than 5 weapons, he can not attack anymore. If you conquer someone you get all of their

production and tools, but you also have to feed their people. It is not necessarily advantageous to conquer your neighbors. You may also let them rule themselves and pay you a tribute of bronze, or tools, or weapons every turn. Some states have bonuses and subtractions from their offense and defense depending on their geography.

Scenario : Stanum's tin mines are conquered by a hostile empire in the sixth turn. The citizens of stanum become refugees or new empire converts. If they convert, their job is to refuse trad at any price for the rest of the game. If they become refugees, they can join other states, bringing 1 bronze or 5 food production units per refugee. This is a military empire from the east that does not allow any trade of the tin to the west. This empire cannot be conquered. This halts the production of new bronze, and produces a need for either finding a new tin supply or finding an alternative to bronze. Once this happens, each state has to figure out how long they can survive without finding either new tin or an alternative to bronze. They are then told about Iron and its abundance, but also that it will be very hard to work with in its current form.

Group 1: Stannum

You are a state with a large tin resource due to your location in the mountains. In fact you control all of the tin supply in the area. You trade for almost everything else. You have very limited food production, as you can only supply 50% of your food yourself. You have some bronze making abilities but they are limited by the lack of copper and fuel, so you trade for much of your bronze. Your demands are food, copper, and finished bronze (tools and weapons).

POP: 100

Tin Production : 10 per turn

Bronze production : 10 per turn

Food : 50 per turn

Bronze tools : 15

Bronze Weapons : 20

Goal : Your goal is to thrive on your tin supply and sustain your independence by building a good defensive foothold. You fear invasion from the empire to the east, but your main concern is to keep your trade roads open and safe. You push for safe trade and wish also to expand your food production. Your population grows by 2 people every turn and your food grows proportionally to your tool growth. You are located on the side of a mountain so your defense gains an extra die.

Group 2: Cuprum

You are an island state with a large copper resource. You supply copper to the entire area. You use this to trade for everything else. You have very limited food production, as you can only supply 2/3 of your food yourself. You have some bronze making abilities but they are limited by lack of tin and fuel, so you trade for much of your bronze. Your demands are food, tin, and finished bronze (tools and weapons).

POP: 150

Copper Production : 100 per turn

Bronze production : 25 per turn

Food : 100 per turn

Bronze tools : 35

Bronze weapons: 20

Goal : Your goal is to keep copper trade strong in order to gain the needed food for the rest of your people. Your population grows by 2 people every turn and your food grows proportionally to your tool growth. You can also gain food from fishing. Fishing can allow up to 200 more food units per turn, but fishing ships must be built in order to utilize this. Each fishing ship produces 50 food but the ship costs 50 bronze production points to make. Fishing boats also require 3 tools each for upkeep but they only last 5 turns. You have a very defensible position as you are an island. This adds two dice to your defense, but by the same token it is hard for you to attack so you lose one attacking die.

Group 3: Bayport

You have almost no resources except that you are a harbor state. Your production capabilities are very high though, as you produce quality bronze, and finish it into tools and weapons. Your people also build ships and can fish. You are a trade state. Your harbor allows trade for exotic goods like silk and beads, and your bronze production gives you a good to trade on land. Your trade companies also organize caravans and therefore control the trade in the area. You have limited food production, currently producing only 20% of your needed food. Your demands are food, copper, and tin.

POP: 250

Bronze production : 60 per turn

Food : 50 per turn

Bronze tools : 15

Bronze Weapons : 30

Goal : To provide and control all trade in the region. To gain more food production through either conquest or growth. Lands prohibit food production allowing a maximum of 100 per turn. Fishing can allow up to 200 more food units per turn, but fishing ships must be built in order to utilize this. Each fishing ship produces 50 food but the ship costs 50 bronze production points to make. Fishing boats also require 3 tools each for upkeep but they only last 5 turns. Population grows at 1 per turn, and food grows proportionally to tools with a maximum of 100. You can ship tin in from far away using your shipping but this takes 5 turns and yields 25 tin. This ship can also get lost. To determine if it gets lost roll a six-sided die on the first and last turn the ship is away. If you roll a 1 or 2, the ship is lost. If you roll a 3 or 4 the ship is delayed a day. 5 or 6 means a safe tripl!!!

Group 4: Fromaccio

You produce shippable foodstuffs like wine, grain, cheese, dates, raisins, olive oil and figs. In addition you produce leather and cured meat. Your grain production also provides food for your state. You have a small ability to produce bronze, but you need it at a quality far superior to your capabilities in order to till the land and cut wood and stone for your farms and graineries. You demand copper, tin and finished bronze (tools and weapons)

POP: 150

Foodstuff Production : 150 per turn

Bronze production : 20 per turn

Food : 150 per turn

Bronze tools : 60

Bronze weapons : 10

Goal : You look for peace and want to provide food for all who need it. You do understand the need for some defense though and keep a small store of weapons. Your population grows by 2 people every turn and your food grows proportionally to your tool growth.

Group 5: Plainsville

You produce a large amount of grain. You are the main bulk food supplier of Bayport. You have skilled blacksmiths who have also begun learning how to use iron although the going is slow. Your demands are copper, tin and unfinished bronze (you can make your own tools from it)

POP: 600

Bronze production : 100 per turn

Food : 1000 per turn

Bronze tools : 200

Bronze weapons : 30

Iron tools : 5

Iron weapons : 5

Goals : You want to be self sufficient. Your population grows 5 every turn and your food grows proportionally to your tool growth. You have irrigated fields but you need very strong tools to plow them. Your blacksmiths have been experimenting with adding more air as well as burning charcoal to make hotter fires in their kilns. They are getting mixed results from this. There is a small river in this state that allows shipping to bayport 6 months out of the year. The rest of the year is spent building up stores. The river cuts through a large hill and leaves an exposed cliff with a strange colored metallic rock on it. Your blacksmiths have had some results with this kind of rock (iron) but it takes 15 production units to make one useful tool out of this stuff. In addition this tool is only good for 5 turns and then it is useless (it can not be reworked), but it makes a great edge and can do the work of two bronze tools. It can also be made into a weapon. The material (iron) seems to corrode over time. You have built a fortress on the hill by the river which allows you to defend your state very well. It adds a die to your defense if you are attacked, allowing you three dice to their three.

SECTION TWO (Science)

V. IRON: THE NECESSARY PROGRESSION

Now let's look at iron. It is stronger and you can find Iron ore nearly everywhere. Why was there a Bronze Age, well after the Hittites started using iron? There are two major reasons why the Hittites dropped iron when given the choice. It melts at a very high temperature and it rusts. Rusting corrodes the iron, weakening it. It is much harder to form into useful shapes, and very hard to work with in general because of the high temperature required to melt it. The advantage of iron is that it is fairly common, found in large ore concentrations nearly everywhere in the world.

VI. BRONZE AND IRON COMPARISON OF DIFFICULTY IN THEIR USE: A STUDY IN TEMPERATURE

You are probably wondering at this point, what exactly is the difference between iron and bronze. Let's start with the metal bronze. Bronze is made from 1 part tin and 9 parts copper. We talked before about the difference in temperature needed to melt bronze and iron. Well just how hot is very hot. Let's start with tin. Tin melts at 232° C but how hot is that. Well, water boils at 100° C, so it is more than 2.3 times hotter than boiling water! That is nothing though, because copper melts at 1083° C, almost 11 times hotter than boiling water. A nice hot hard wood fire in an oven similar to those used to fire

pottery could reach this temperature, and the copper could be mixed with the tin and made into bronze. The bronze could be re-melted at 1050 degrees Celsius. These enclosed fires could get iron red-hot (hot enough to bend and work) but one needed to be able to reach 1537 degrees C to melt iron. This is almost 500 degrees hotter than the temperature needed to melt copper.

In order to work with iron, furnaces had to be made that could burn hot enough to melt it, since open fire burning alone was not hot enough. A charcoal fire sometimes gave off enough heat. The needed temperatures could be reached by burning charcoal or anthracite, a hard black variety of coal, in a furnace (usually brick or stone) enclosure. Also, bellow pumps that added oxygen to the fires was necessary to reliably reach the necessary level of heat. This smithy equipment took a long time to develop, and in the meantime it became harder and harder to get tin. Once the furnaces had advanced far enough to make iron relatively easy to make, bronze became less essential and less valuable.

VII. THE IRON TO STEEL TRANSITION

The iron could also be heated and worked to make wrought iron, which is essentially steel. Steel, like bronze, is an alloy. Steel is a mixture of iron and carbon.

The modern steel-making process begins with iron ore. First, in a large extremely hot furnace called a blast furnace, the 3% of impurities from the iron are burned away mostly carbon and phosphors. Then, once only pure iron is left, a small amount (approximately three tenths of one percent) of carbon is added to it. However, it

is not really a matter of additives but rather changing the proportions of iron to carbon.

The resulting metal, named steel, is extremely strong.

In Pre-industrial societies, blacksmiths would actually be doing roughly the same process by heating and working the metal. They burned off the impurities a bit at a time to end up with wrought iron that had just a little bit of carbon left. Instead of using of using a blast furnace (since that technology was not available) to remove all of the carbon and other impurities and then add the correct amount for the mixture, they would instead "work" the metal with a hammer for a long period of time. Working the metal meant that it was heated and then pounded by hammer usually on an anvil. This process would also remove some of the impurities in the iron ore by burning them off and pounding them out. If the Blacksmith got lucky (since there was really no way to tell exactly how much to work the metal, since it was a matter of experience), he had removed just enough carbon and left enough in to make the wrought iron as strong as steel. If the blacksmith didn't work it enough, then too many impurities would remain in the mixture and it would be weak. But, on the other hand if he worked it too much, then not enough carbon would remain to strengthen the iron ore so it would be weaker than steel. There was an optimum point to stop.

Wrought iron could be very strong and the raw material was abundant, so it was cheaper than tin and therefore slowly replaced bronze. The labor component drove up the cost of iron and made it expensive. Unfortunately, there was really no choice since the supplies of other metals were too limited for the growing demand for metal.

Iron and steel were used in both weapons and tools, just like bronze had been. In order to make these metals, as already mentioned, the wood fires needed to be hotter than

they needed to be to make bronze. The open wood fires could not reach this temperature without help, there had to be a furnace. Blacksmiths needed bellows to pump oxygen into the fire, and ideally, a hotter burning substance like charcoal or coal was available to be burned. When iron was first used, these methods of making hotter fires were not known.

It took time to discover how to get anthracite coal hot enough to burn and learn that bellows could be used to superheat the fire, so the first iron tools were crude and weak, and only the richest iron ore — those that literally rusted in the rain, would do. It was not until hotter fires were made that iron became useful in the form that you could find it nearly everywhere on earth

The need for bronze substitutes drove a search for a way to use that which was abundant. It became known that a hotter fire was the key to better, faster iron work and so experimentation was going on all over Europe and not just Europe. Damascus “steel” was for a time the world standard for excellence, and used primarily in distinctive curved swords.

Iron replaced bronze because of the breakdown of the trade routes that supplied the tin. It was not necessarily a better metal, in fact, bronze is superior in many ways, but iron became the cheaper and more available substitute. Why would you pay four times as much for a bronze tool or weapon when you could buy an iron one that was sometimes stronger? The bronze one may work a little better and last longer since it didn't rust, but the wrought iron one can be replaced four times before the cost equals the traditional bronze tool! However, there was one good feature about bronze that kept it popular for a long time and that was that it was reusable, meaning, if a tool got really banged up or

broken, it could readily be melted down in a wood fire stove and another would be made from the same bronze. Iron took a specialist with special equipment to repair or reuse it. However, as blacksmiths got better at working with iron, it became routinely reusable too, if the original piece wasn't too badly damaged or rusted away. As the population of the world grew, there just became too little bronze for everyone's needs anyway, so the tougher more difficult to produce metal had to be used.

We have mentioned that once blacksmiths got better and better at using iron, it became nearly equal to bronze. There is one area, however, where iron falls well short of bronze. Bronze does not oxidize, or rust, and iron does. Rusting occurs when the metal bonds with the oxygen in the air. The rust, unfortunately, weakens the metal. In order to counter this rusting, medieval people had to use polishes and oils to keep a protective layer on their important weapons and tools between the metal and the air. Thus, wrought iron required a much higher level of maintenance than bronze, especially before it could be painted.

There are several theories about how iron was first noticed and how it began to be worked. A favorite involves Iron pyrite, often named "Fools Gold". It is nearly indistinguishable as an ore from actual gold until you try to melt it or bend it since it. Since, it was actually an iron ore it couldn't be worked at the temperatures used for gold work. "Fool's Gold" became an object of much attention by the Goldsmiths, (blacksmiths who specialized in manipulating gold). Due to "Fools Gold" and the Hittites conquest of Mesopotamia, Middle Eastern people got some early experience with iron during periods when lead gold and silver were the important metals besides copper

and tin. (They were soft and easy to work with due to low melting points you could reach with an open fire.)

What did this Iron Age economy bring with it? Iron ore was everywhere and therefore metal trade was not needed to prosper as a state or. Rather it is skills and equipment to work with the local ore (which varied in quality) were what moved from place to place as the area “developed”. There was no reliance on others living elsewhere for your tools they could not control your power or growth by withholding metals needed to make tools or weapons. However, a competitor with a better extraction or manufacturing process or access to richer ore or better coal, a superior design, whatever might produce more or better tools and weapons grade material, did have an advantage over you. This would give them an “edge” (pun intended) in economic competition or warfare.

VIII. THE HAZARDS OF THE CRAFT

When bronze was being discovered other metals were often used in place of tin, as an experiment or by mistake. White metals like antimony were especially likely to be mistaken for tin. However, gold and copper mixes have also been found and they must have been experiments. Another metal that looks and feels like tin was sometimes used, though it was slightly heavier. It was called arsenic. It did the same thing as tin when it melted into copper and that is, it created a type of bronze. Does anyone know anything that makes arsenic different from tin? It is poisonous (deadly as fumes or you breathe

especially if you eat it). It can kill you quickly (if you eat a lot) or slowly if you absorb it a little at a time.

The smithy was at risk of being poisoned if people brought him the wrong white metal and he couldn't tell the difference.

Slow arsenic poisoning has several stages and one of the earlier ones involve going lame and limping as one becomes increasingly crippled and loses the use of ones limbs altogether.

The Greeks noted that many of the really good armorers suffered this fate - thus their mythology includes one and only one" crippled " God on Mt. Olympus, "Hesepheanes". The smithy sword and armor maker of the Gods was lame. According to legend, he was born this way, and it offended Zeus enough that he was cast out of heaven, but earned his way back by his artistry, skill, and usefulness. Occupational hazards have a long history.

"Silverware" has a long history as eating utensils. What do you think would happen if you made these tools out of the stronger bronze - but couldn't be sure just what that "white" metal was which was used to make it? There is probably quite a story in the custom of using soft easily tarnished silver rather than strong and attractive, no rust, no tarnish bronze for cooking and eating utensils. What if there were two city-states side by side, which for no reason at all, just had different traditions. In one, you eat with your left hand using silver or wooden implements based on your wealth and anything else is gross and unseemly. Bronze is only used for swords and tools with handles. In the other, you eat with your right hand using gold and bronze implements in the fire and for handling food, as well as for tools and weaponry. These are a practical people and bronze is the

superior metal for cutting and won't burn like a wooden fork. Over time which state will thrive, be known for hale and hearty people who live to an old age without infirmity? Which will come to dominate the other militarily and which set of customs will become the norm throughout the land?

One doesn't really need to know why a custom is important for it to have an affect on history, the rise, and fall of nations and what we call civilization. However, the idea that "silverware" is to be made of some metals and not others has comedown to us over the years.

For example, what if a great scholar was to rise to fame in the city of the lame and report that after a great dispute with the local bronzeman, he and his family had refused to use any of his ware, instead importing them from a family member in another city who got his tin from another source.

From that time on, his family had been spared the continuing plague of infirmity, which had become universal in the house of the local smithy and common throughout the city. Hence, he had undertaken careful study of the white and yellow metals each smithy used in making bronze and there was a difference in the white. You could tell the two apart with a balance scale.

What would happen then - in this tale of two cities - with a "certifier" and assayer of metals in the one afflicted by crippling disease - and a connection made between the nature of the bronze in use and the illnesses that had afflicted the people for generations. The second city can now use White metal brought from anywhere safely and has created new job categories for people to train to be specialists in classifying and studying metals and chemicals. Who, now has the edge now in economics or military competition, the

city with the safe source of tin that does not know why it is safe or the city that learned the hard way to distinguish tin from other white metals?

People will soon find “practical” uses for the other metals especially the deadly one. How handy it was for dealing with rats and other pests, (such as tyrants). Rulers will soon employ food tasters or testers and alchemists to try to protect themselves - and deal with their enemies.

Hence, a complex division of labor with lots of “specialists” have long been a Hallmark of more developed civilizations with a greater command of what we’d call science and technology today.

Of course, the “Alchemists” could not always please the ruler. For centuries, someone was always trying to turn lead into gold - under the sponsorship of many rulers - always to fail. Hence, they figured out that some materials were “elements” that could not be broken down into other things or changed. Others were “compounds” and could be broken down - always into the same list of naturally occurring elements.

The elements known in ancient times still have symbols or shorthand notations based in their names in Latin- for example,

Silver	-	Ag	Argentum
Gold	-	Au	Aurum
Copper	-	Cu	Cuprum
Lead	-	Pb	Plumbum
Antimony	-	Sb	Stibium
Tin	-	Sn	Stannum

One of the great moments in Science was when the Greek “Scientist” Archimedes was asked by the king of his city state to see if an elaborate new crown he had made was really pure gold, or whether less precious metals had been mixed in. He considered it too light - but don’t damage

Archimedes knew he had to compare the weight of the crown to its volume - but how could he measure the volume of such an ornate piece of metalwork?

Contemplating the problem, as he entered his bath he noticed the water displaced by his body rise up along the side of the tub. He raised himself out of the water, the line on the edge dropped - he entered slowly, very slowly - no waves - and it rose again - to the same wet mark as before.

Leaping from the tub - he ran naked through the streets yelling “Eureka, Eureka” (I’ve got it, in Greek), and still glistening and naked burst into the kings chambers to tell him of the plan to measure the volume of crown without damaging it. (It did not turn out to be pure gold) To this day, when an answer comes to a scientist suddenly - they call it a “Eureka” (“I’ve got it!” in Greek) experience. Most do remember to get dressed before reporting the results. However, some scientists and engineers will write on anything handy at such a moment and several have had to replace the table clothes, they insisted on taking with them from a restaurant.

ALLOY MIXING AND SWORD MAKING

A major point in the Bronze Age lesson was that copper and tin, both previously used for weapons, could be combined to produce something called an “alloy”. An alloy gave the best qualities of both materials used to form it and in this case, was harder than either of the two components used to make it. After several failed tries, I decided that it would be very difficult, if not impossible to actually make any kind of experiment in an elementary classroom to show a real alloy formation. I did however, have a good deal of success in a simple mixing of two like materials of DIFFERENT COLOR to make a material that could be used to “make a sword”. It is interesting to note that one type of metal casting called the “lost wax method” uses a wax model of an object (in this case a sword) to form the metal product. The wax model is pack in sand and then the molten metal is poured into a wood casting box. As the metal flows into the cast, it hits the wax, vaporizing it and taking the form of the model. In essence, we are performing the first step in the “lost wax method”. The procedure is as follows:

Materials needed:

Two colors of candles or candle wax

A metal or Pyrex container in which to melt the wax

A hot plate or candle as a heat source

A stirring rod

A metal or glass baking pan, as long as you want your “blade” to be

Enough beach or filter sand to half fill the pan

First we break up sections of both color wax and place them in the melting pot. It is then placed on the heat source to melt. While this is occurring, a mold of a sword is fashioned using your finger or stirring rod in the sand that lines the baking pan. After the wax has melted, show the students how the two colors have combined to create a new color, just as the copper and tin combine to form bronze. Then, carefully pour the melted wax into the sword mold. In a short time (2-3 minutes) the wax should have hardened and cooled enough to remove from the sand mold. Then explain how the blacksmith would have to remove any roughness left from the mold and add an edge to their new “sword”.

SECTION THREE (Technology)

IX. ARMS DEVELOPMENT AND THE GROWING NEED FOR ARMOR

What is an arms race? The following scenario should help you grasp the concept. The following is not a history lesson about a real event so much as a story with moral to help explain what an arms race is, as a concept.

Imagine for a minute that you lived in a different time. Suppose for an instant here that you were a caveman alive many thousands of years ago. Now suppose that there were two groups of cavemen: one of the groups was your friends and the other group was moving in on your traditional hunting grounds and wouldn't leave. Essentially, they are your enemy since in the end either they or you will have to leave, the area cannot support everyone - so some or all of you must leave or all will starve.

The enemy group could at any time attack you and try to take your food or whatever else they might want to force you out of your land. How would you defend yourself from these attacks? Well, you'd probably fight with your bare fists or use your nails or teeth perhaps to ward off the attack. Well, then what if one day the intruders returned with strong sticks or clubs to attack you with? They would certainly have the advantage if you were only fighting with your bare hands. Then after that fight you lost and had to flee, your group would probably want to get sticks to defend yourself with, so that you could have a more even chance.

At this point part of your time and resources go toward defense of your goods and friends, when before this point you didn't really think of this at all. You only worried

about finding food for yourself and your friends, but now you have another concern: tools for defense. The next time they come, you and your friends are ready - and have your women up in the trees overhead with baskets of rocks to drop on their heads, if they get too close. You have planned with your fellows to fall back and fight under the trees if they are winning due to better use of sticks. They go home with headaches and bruises, so you figure they won't be back again.

But they do come back and instead of just sturdy sticks, your enemies now come and attack you with sticks that have sharp ends - some with pointed rocks attached to them and they stay away from the trees and throw some of the pointed sticks at you when you hide under the trees. Now your group will have to fashion some way to strike back at a distance - after throwing sticks, hatchets and spears are likely to emerge. In short, you will escalate the war of brains and tools as well as brute force in order to make the fight even again.

One day you get the idea that maybe if you took a strong flat piece of wood and attached it to your left hand, and carry a hatchet in your right hand you will be better off in the open. With the wood you have created a shield to block attacks and you can still attack with your right arm. Next, you get the idea that if you attached pieces of strong wood to key parts of your body, then you would have two arms free to attack and you would still be somewhat protected from your enemy attacks. Thus, you create the prototype of armor.

This idea of increasing attacking power with better weapons and defending power with better shielding, results in an unending spiral of improvements in technology designed to get at least a temporary advantage. The economics of supporting and

developing the craftsmanship is also part of this competition for the land created). This is called an arms race. Escalation of military means to give one side or the other an edge in the next battle or war soon became a specialized full time occupation for the Armorer and the Swordmaker. It was a battle of wits, courage, and skill in the medieval period with some full time soldiers and armorers.

In time, as groups tried to find better and better means of defense, they of course created better and better weapons. In the Medieval Age, we are primarily concerned with swords and suits of armor in terms of weapons and shielding. However, horses, their training and equipment and castle fortress design and architecture are all part of the same preoccupation with defense and offensive strategies to overcome new defenses used by the other side. Actually, a professional wanted to know of any new device or strategy used anywhere in the known world, as they could be up against someone with similar knowledge.

X. THE ARMORS PRODUCT LINE: ARMOR TYPES FOR EVERY OCCASION

There were essentially three types of armor: mail, plates, and helmets.

Mail as we noted before is comprised of linked rings and used to block sharp stabbing instruments and slashing type attacks from swords and other bladed weapons. Plates of iron as we mentioned earlier are also used to stop these attacks. They can stop attacks by blunt weapons such as mace in addition to slashing attacks from sharp weapons, but are less flexible.

A helmet is constructed from iron, and protects the head of the wearer. It is typically found and the only other factor of note is the eyeholes. Some had only two small holes in the front for the wearer to see through. Others had visors that flipped up to allow the wearer to see better when not directly engaged in combat. There were small holes to see out of when he was at battle and the visor needed to be put down. These sturdy, but heavy pieces of iron protected the head of the person wearing it from most blunt and sharp attacks.

These three things (mail, plates, and helmet) were combined to complete a suit of armor. A person generally wore some sort of soft shirt and pant under the armor. Then they wore a breastplate, a large plate of iron that protected the back, stomach, and chest. The breastplate had holes for the arms and the head of the wearer. The helmet was attached onto the breastplate so that it would not accidentally come off in battle. The arms had a series of small plates attached together, so that the wearer could move his arms and still be protected from attack. In places where these plates didn't perfectly meet, or where they met the breastplate, mail was attached so that the body was covered in case the plates moved during battle. The hands wore either mail gloves, or a combination of mail and small plates put together called gauntlets. These gauntlets protected the wearer from getting his hands injured during an attack. The legs were protected by a series of plates similar to the arms. The feet were protected also, being encased with iron boots.

Not all suits of armor were alike. Due to the way that they had to fit the body closely, they had to be personally made and sized for the individual wearing the suit. They were very expensive. Also, there could be up to three different kinds of suits of armor, named for their individualized purposes. There were battle, joust, and ceremonial

armors. Battle armor was plain and simple; no fancy designs since its job was mainly to protect the wearer in battle so the smoother the surface, the better. Jousting armor was normally only used in sports-like competitions.

Jousting armor has a strong thick piece of metal attached to the breastplate for protection in case a lance would hit there during the joust. The jousting helmet also was specially shaped to protect the wearer's eyes from stray bits of wood that could fly out after a blow to the opponent's lance. It was also bolted to the breastplate in a way that allowed no turning so that the user would not break their neck if roused from their horse. This would be useless in a real battle but reduced the injury and death rate in their practice and sports-like warfare. Further, trials by combat using "champions" was not unheard of and so this jousting armor was not just for sport.

Ceremonial armor was used mainly when nobility attended a banquet or other functions. This armor was lighter than regular battle armor, and they generally had fancy designs on the exterior surface. The armor was primarily used to show importance or wealth, and to generally impress people while socializing. It was not as good as battle armor but better than nothing when one was in the public eye and could face an assassin or traitor who could strike suddenly and without warning - when you weren't prepared. So armor was considered decorative, but wise, when out in a "friendly" crowd or on one's own in a setting with potential enemies in peacetime. The kinds of things that promoted duels were numerous in an aristocracy that did things as a matter of "honor" so one could really not predict when a fight would ensue. Prudent people carried a "blade" and wore ceremonial armor in public. The chivalric code was as evident on the parade ground

when practicing as on the battlefield forced. Some sort of armor was worth wearing most of the time.

It was just a normal part of the dress of male nobles at the time. Remember, a very small part of the population was ruling over the large majority with an “iron” hand. However skilled you had to be to prevail over a similarly equipped opponent-in a clash with rebellious local rabble on foot and without armor, there would be no contest. Wearing armor when out amongst the people, at least an ornate breast plate and helmet, was the common practice for a good reason. It was both the symbol and means of asserting authority and extracting tribute from the people.

XI. TECHNOLOGICAL ADVANTAGES OF ARMS AND ARMOR

In the beginning of the Medieval Age, bronze was the primary metal used to make swords (as we saw in the earlier modules and role-playing game). Trade route problems made new bronze became unavailable; people still needed to defend themselves. They made swords out of the metal items that they had around, which were increasingly made of iron. These swords, while not as good as bronze in some ways, were better in others and allowed the Europeans to protect themselves from attackers with access to bronze.

In terms of armor, linked rings called mail had been around for many years. However, the problem with linked rings was that while they could stop a cutting blade, they couldn't stop the attack of a blunt object like a club, or a club with several sharp spiked metal balls attached called a flail. The person wearing the armor received no protection from blunt attacks like that and once one's bones were broken and organs

crushed, one was helpless to resist the blade to follow. So what was the next step in armor to protect against both blunt and sharp attacks? It was plating. That's what we normally think of when we mention suits of armor. Plates of steel are fitted for a person and then they are worn at nearly all times when they are at risk of attack. These plates would stop the sword punctures as well as the blunt attacks.

By this point in history, however, a change had developed in the culture and social structure of the people of Europe and their adversaries. Before the iron age, some thought and effort for each day was put into gathering food and staying alive, but now since the weapons needed take so long to make and are so costly, it is not possible to work on both defense and gathering food. Specialization in terms of the construction and use of arms is required of some, and others must produce enough extra to feed and clothe specialists as well as themselves. (Sometimes called a “surplus”.) Thus one starts to get an idea of the real cost of the means of war in terms of how many serfs with how much surplus on how many acres of land it took to support a single mounted knight, and that includes his family, horses and their armor too. It turns out that putting a heavy cavalry line of 100 horsemen fully equipped and supported took the coordinated efforts of 1000's of people some of whom were specialists, most of whom were farmers.

Previously, we discussed swords and suits of armor in order to understand the concept of an arms race. However, there is more to learn about the weaponry and armor of the times before one can estimate the scale of operation necessary to support the military technology of the period.

Many swords existed in this period. We know swords to be thin metal objects that are sharp on both sides. On one end is a point used for stabbing an opponent, while

at the other end is a handle for gripping the sword firmly. These swords ranged in shapes and sizes. Some swords called foils were thin and light and were used for decoration and a precise type of swordsmanship called fencing. Shorter length swords, likewise called short swords, were also used. Then there were the normal length swords, or perhaps long swords that were primarily used by a knight. These swords were generally placed in a scabbard, a rigid covering for the sword and worn about the waist. Finally, two-handed swords existed which had large grips for two hands to hold. These swords, because of the increased size and weight, inflicted greater wounds on the opponent but were clumsy and slower in movements - especially in recovery to strike again if one's first blow was "parried".

Blunt weapons were also used at this time. The club, simply a strong piece of wood with a grip was mentioned in the previous module. The flail was widely used also. It consisted of small steel balls, approximately the size of a golf ball attached to a spiked stick. They were attached to the stick by straps of leather. This weapon was swung around the head until the balls were moving at a great speed; then the person was hit with the balls. This obviously caused a great deal of blunt damage. The mace was a variation with only one larger ball on a chain often with some sharp points studding the heavy surface.

Possibly, the next most prominent weapon of the era was the lance. A lance was used by a person riding a horse. A lance is long and made of wood, perhaps 6 to 8 feet with a grip on one end and a point on the other. A rider firmly grasps this lance and charges at the opponent. If successful, the point of the lance pierces the opponent quite violently. This attack can be very damaging because of the high speed that the horse has

reached when the opponent is hit. There are several types of these lances, but the two most commonly used types are the normal lance for battle use and a jousting lance. The heavier and stronger lances were used in real battles to attack the enemy.

The jousting lance tended to be much lighter, as they were only used in sporting competitions called jousts. The longer lighter one was to allow one to hit the opponent and throw him off balance before he hit you. These competitions were huge events for people of all levels of society to watch. Only the nobility were invited to compete however. In these competitions, two riders would salute the host of the games. The host organized the game and festival and usually offered a cash prize for the winner of the jousting competition. Next, the riders would ride to opposite ends of a field. They would then ride at each other and attempt to knock each other off of their horses with their lances usually from opposite sides of a small wall to keep the horses going in a straight line when the rider couldn't see very well. The winner was the rider who was still on his horse at the end. Obviously the person with the longer lance had the advantage-up to the point at which it would be too heavy to control or break like a matchstick.

Other competitions of this kind started with a joust, and then the participants finished with a sword battle. If both were unhorsed, they would turn to the sword immediately. If one was, the other typically dismounted to keep the final competition "fair" and the crowd would approve of such "chivalrous" behavior. The art of war was for honorable "gentlemen" in this period. A noble tended to serve as the officer for a body of "men at arms" (foot soldiers) in a real battle, though some units were entirely made up of cavalry. So thus was a competition of the officer and horse specialists only.

ARMS AND DEFENSE GAME:

The purpose of this game is to exhibit the theory of arms races and defensive structures in combat of the time.

Divide the class into two games. Each game is comprised of 4 or 5 teams of 2 (or possibly 3 depending upon the logistics of class division.)

Each time will have:

- 1 bag of defensive structure pieces. (Wood blocks 1" x 1" x 3")
- 1 bag of offensive power pieces. (Wood blocks 1" x 1" x 6")
- 1 home position marker (small coaster sized cardboard disk or piece of paper)
- 1 army position marker (similar marker as above or possibly plastic figurine)
- 1 defense power measuring stick (ruler with marks every 3")
- 1 offense power measuring stick (ruler with marks every 6")
- 1 bag of defense dice (red dice)
- 1 bag of offense dice (white dice)
- 1 deck of wildcards lettered A-Z for each team in play

Setup:

Each team starts off by taping their home position marker to the floor in a spot where they have adequate room. This marker will not move for the duration of the game. The group's army position marker starts off next to the home position marker, but is not taped to the floor as its position may change during the game. Every team starts off with 6 defensive structure pieces. These pieces must be stacked in alternating directions in rows of three (as in Jenga.) creating the "castle" or defensive strength monument. This

represents the defensive strength of that team's castle, and as such should be erected near to the home position marker. With this setup in place for all teams in the game, game play begins.

Game play:

At the beginning of each turn a team may decide to move their army. (For the first turn there is no army to move.) The army may either be moved from wherever it is to another team's home manor. The team of course has the option to keep their army in the same place if they desire. If the army is already at another manor it may either stay there move to a different manor to attack or move home to defend. The army must always be considered only one unit regardless of the offensive power accrued.

Once the position of the army for this turn is established, a die is rolled (perhaps two dice totaled for quicker game play). The amount on the die is the number of total production pieces that have been made in the last year. (If the die roll is a 6 and the production die roll was a 6 the previous turn then the team gets a Wildcard, explained below. The Wildcards are given in order from A to Z. The first team to get one gets the A card, the next team the B card, and so on. The letter doesn't change the effectiveness of the card, it merely allows them to be told apart.) The team may take this total number of either defensive structure pieces or offensive power pieces to add. A combination of both offensive pieces and defensive pieces may be taken so long as the total number of pieces does not exceed the die roll. Defensive pieces taken are added to the castle structure, always building in the alternating 3x3 row pattern. (The strictness of this pattern represents the fact that if a lord desires a castle of any worth, he must follow a strict engineering plan.)

If the army is away, then the offensive power pieces being added are subject to robbery and ambush during transportation to the enemy manor. As such a die is rolled to determine the amount lost. The number of lost troops per this die roll is listed below:

Offensive power pieces lost in transit	
Die roll	Troops lost
1-2	0
3-4	1
5	2
6	All troops being sent are lost

No more troops can be lost than are being transported to the rest of the army. If the army is at home then this table is not used, and all power pieces are added.

Once the number of offensive power pieces to be added to the offense monument has been determined, then they may be stacked anyway that the team sees fit. The only contingency is that old pieces may not be touched in placing new ones on the monument. Also if any pieces fall in the process they are considered lost and must be removed. (The groups must strike a balance between power and stability, since the height of the offense monuments determines the attacking power of the army. It would be simple to stack several army pieces end to end to achieve great height and power, but it will surely be knocked over if any attempt to add to it is made. But if the group tries to build an army too slowly then its height will take too long to give attacking power. This method for army power is supposed to symbolize a massive hiring of temporary troops (the quick vertical stack) to the slow process of upgrading attack technology (the slow but well foundationed monument method.)

If the team decides then they may forfeit their production for the turn for an increased chance of an arms technology advance. Instead of getting production, the team gets to roll a die. If the die roll is a 5 or a 6 then that team gets a Wildcard for technology

advance. The team gets whatever card is next in the alphabet. If the roll is otherwise the team gets nothing.

Next any battle that is going to occur takes place. First priority here is the armies that are outside of their home territories. If more than one army is away from home and is attacking an enemy manor, then a die roll for the highest will determine which foreign army attacks first. Next the attacking army measures its offensive strength monument with its offensive power measuring stick. This determines the number of dice that the attacker may use to attack. The attacker may attack the enemy's castle in an attempt to take it over, or the enemy's army (if it is there at the time.) The defending body, either the castle or the army determines its strength with the appropriate measuring stick (i.e. offensive power measuring stick for an army or the defensive strength measuring stick for the castle.) When the number of defending dice are determined, the attacker rolls their dice and the defender rolls theirs. (Before the dice are rolled the attacker or defender may use their Wildcard. The Wildcard adds 1 to whatever is rolled on all of that team's dice. The only problem is that once a certain wildcard is used upon an opponent, that opponent has been exposed to the technology and thus acquires it. Thus both teams have the Wildcard with whatever letter was being used. Wildcards are not used up, they may be used as often as desired. Multiple Wildcards may be used by both teams in any battle.) The dice are paired highest defending die to highest attacking die, next highest defending die to the next highest attacking die and so on. If after any wildcard bonuses are added for the paired dice the attacker's die exceeds the defender's die then the defender loses either an army or a piece of castle structure. Thus they must remove a piece from either their attacking monument or their castle depending on what was being

SECTION FOUR (Social Studies)

XIV. SOCIAL STRUCTURE: THE CLASSES AND A WORKING HIERARCHY

People: Estates

The relationship and interaction of the different estates defines social life in the medieval period. First, a description of the estates separately is called for to understand how they fit together. The first estate was the nobles, the warrior class. Since they have been discussed to some extent already, we will begin with the second estate, the Clergy.

Clergy: The Second Estate

Religion played an extremely important role in the lives of medieval European and most of the people they encounter during an invasion. The church and its hierarchy members comprise one whole estate because of its importance to everyone in the society. This, we would call a social class, not that all people in the privileged group were in a powerful position.

The least powerful members of the clerical hierarchy were the priests. Priests headed churches or parishes. Parishes were sections of countryside whose people attended a single church. Every Sunday, priests held mass at the church and everyone was expected to attend. In addition to weekly masses, the priests would conduct weddings, funerals and care for the suffering (sick or poor). Often the churches were the best-built structures in the entire village. The costs of the construction and maintenance of the church and the priest's house, as well as other financial needs, were funded by tithes. Tithes were flat percentage taxes of the people's annual salary, usually 10%, given

to the church as weekly offerings. Additional contributions would be made during special events and religious holidays.

Groups of parishes and their governing priests were ruled by bishops. These larger regions that the bishops controlled were called dioceses. Bishops ruled in law cases involving the church. This law, called canon law, often involved wedding and inheritance disputes, or even criminal charges against members of the clergy, a monastery or even a convent were also handled by the church. They often had administrators and archdeacons for this purpose. As the priest controls a parish and a church, the bishop controls his diocese and especially his cathedral. The cathedral was the capital church for the diocese and usually by far the grandest edifice in the land.

The archbishops could receive appeals from people who were dissatisfied with the rulings of the bishops. These archbishops presided over all the dioceses in one kingdom. If one was still unhappy with a ruling of the church by an archbishop, then one could appeal to the College of Cardinals and the Pope in the Vatican. The Pope was the head of the entire Western Church and the greater power that he had at his disposal was excommunication. A person who had seriously breached church policy and practice might be excommunicated; meaning that person banished from the church. The excommunicated could not marry or receive proper funeral service upon death. They would most likely be shunned by friends and family who feared excommunication themselves if they accepted or helped this individual who was “ungodly”. The Pope was considered the spokesman of the word of God here on Earth. Kings were crowned at the hands of high clergymen and thus, the threat of excommunication was a severe penalty to the royalty.

Who wanted to serve under an unrepentant sinner? Could God's enemy prevail in battle? Would the crops grow? Would plague be visited on the land? Was one required to take orders from a King whose crown was revoked by the church? Wouldn't a noble who overthrew an excommunicated king be likely to get the blessing of the church to establish a new lineage for the Monarchy? This gave the church the power to control both kings and nobles with the threat of rescinding the blessing and endorsement of the Catholic Church.

On the outskirts of this hierarchy are the monks. People who wished to seriously dedicate their lives to God and theological study without the distracting politics and secular clerical tasks of the clergy system might choose to live in a monastery. These monasteries were generally self-contained units formed for religious study. They contained all the elements that the monks needed to survive and study. Churchmen, especially Monks, were among the few educated members of this medieval society and they wrote most of the books that chronicle the period. Clergymen outside the monastery were also literate and were also often recruited to work for the state or the monarchy. Cardinal Woolsey in England and later Cardinal Richelieu in France were two of the more famous examples of power behind the throne who kept the books, ran the administration and really ruled the kingdom for the official king who had the noble blood but not a head for administration.

Lords, Knights, and Kings

Next in our examination of these feudal times in terms of estate, is the nobility or the lords of The First Estate. As the important element for the clergy was the parish, the important region of countryside for the Lords was the manor. A Lord 'owned' all of the

land in his manor, by being a vassal to a greater lord or a king to whom he owed faithful service. Peasants, or common people, had to pay him for the use of the land. The form of payment was typically by giving the lord a portion of their crops and livestock, or a portion of the sales from these goods. A manor might be extremely large and contain several villages or be small and contain only part of a village, or it might simply be that one manor and one village coincided.

A lord typically had a stronghold, its size would depend on his wealth, (and wealth was determined by the amount of land owned). A wealthy lord would most likely have a full castle fortress, and weaker lords would possibly merely have a large fortified house. The lords were very concerned with defensive measures for much strife came from maintaining one's own lands and acquiring new property. The lord's agreement with his peasants involved protection. The lord sought to protect the peasants and their fields and homes, as well as the land of his manor, from attack by foreign invaders, marauding bands, and other nobles. They would achieve this by employing knights. Often the lord himself was a knight, and if he wasn't particularly wealthy, he might be the manor's only knight. Knights wore armor and shield and rode upon a horse into battle. Along with a knight, several foot soldiers would accompany the lord to battle. These forces, the lord hoped, would be sufficient to defend his land from attack should it arise. If not, he could appeal to his lord for assistance. In return, the lord could call upon his vassals to raise an army to attack a neighboring manor or kingdom as well as to band together to ward off a threat.

A lord could obtain lands directly from the king, from a greater lord, or even from the church. These three bodies would give the lesser lord a region of land as his own.

They would give him control of all of the peasants on this land and freedom to rule as he pleased for the most part. The peasants were not personally owned, but rather they were bound to the land that they worked on so that they were transferred with ownership of the property. Land without farm folk was not productive and in medieval times really had no economic value. In exchange for land, the lesser lord had to swear an oath of loyalty to whoever granted the property to him (king, greater lord, or church) in a ceremony of homage. The land in this agreement was called a fief and the powerful individual giving the fief was considered the lord and its recipient was the "vassal".

The oath of loyalty dutifully bound the vassal to his lord. The fief the vassal received also came with many burdensome responsibilities. The vassal was required to come to the aid of his lord in times of battle. Not only did he personally need to come to his lord's assistance so did his knights, foot soldiers, and archers. The vassal had to train his henchman for battle and set aside at least 40 days of service to his lord. Past the 40 days, however, the lord was required to pay the vassal for his services. The difficulties of such a system of land tenure will be discussed further after the overview of the three estates. In addition to receiving land directly from service to a lord, property could be inherited through primogeniture (first born male - who survives - gets the manor) or acquired through marriage.

Knights that weren't specifically heads of manors were soldiers of fortune, still above peasants and thus were considered nobility but landless wanderers - swords for hire. Often they were younger brothers of the oldest son who inherited the manor. Second sons often joined the clergy, especially if they were handier with a book than a sword. This left the third, fourth, etc. sons to become knights who were available to be

forming into cavalry units as they were lords by blood and might have some money but owned no land and without a lord supporting them could not afford their house and armor. Combat for a knight was different from combat for normal foot soldiers. They were not only given much more freedom and privilege, but they were harder (and too valuable) to kill during battle. Generally they were captured and treated like guests by the capturing lord until a ransom was paid for their release. Knights were expected to be of exceptional moral character and etiquette. They prided themselves on learning, gentility, and prowess with the ladies. They could dance, read had relatively good table manners and treated each other with the respect that accompanied their station.

The kings of the time were somewhat different from the all-powerful monarchs and emperors that one encounters in other periods of history. They did not have absolute power, except perhaps with the peasants working on their own manor. A king was a lord who through the luck of successful marriage, inheritance, or an auspicious battle record acquired a great deal of land. Thus, with all of this land they were able to control many lesser barons and be the strongest of their peers. Kings also received money from the manors that they gave out to other lords. Thus with money coming in from all over his land he would be able to fortify his stronghold further, employ more knights, and conquer a weaker but rebellious or disloyal lord's property. He could also withdraw a fief and let neighboring lords compete to throw the disloyal vassal who had lost favor off his lands without moving a soldier of his own. He could encourage, discourage, or ignore the competition for land and power among his nobles. Normally, however, the king wanted to see them divided and weakened, so no one would be able to consolidate a power block equal to that of the king hence, feuding and taking each others land and castles was

discouraged. Coming to have grievances judged by the supreme Lord in his court was encouraged.

The relationship between the king and his vassal lords seems simple in theory, but in practice, it was a bit trickier. This will be discussed in further detail as we proceed, but suffice to say that kings were seldom the all-powerful rulers that their lands and heritage entitled them to be. Often the barons had more men under their direct control and the means to support them better than the king. When this happened, the king could not control what they did on his lands, regardless of the fact that he bestowed them on the baron in the first place. In principle, the king could take back the land, but unless he had the support of other barons, he didn't have the power to do it. He would be forced to wait until the baron was threatened by another power. Then the king might remove the land from the weakened lord or bargain with him by offering protection in return for more control of affairs of his land.

Only a serious, outside threat could really unite the lords of the land under their king. Even then, if it looked like he might lose, they might make private deals with the invader so as not to lose their lands, if the king was deposed. The invading knights (all those third and fourth sons hungry for land of their own), would be expecting their hopefully victorious king to take the lands of the vanquished and distribute them among his loyal supporters. Hence, treachery on the part of the vassals of a weak lord was common. How else could they protect themselves and their families if he was expected to fail?

Common Folk

The third estate is comprised of everyone who was not nobility or part of the clergy. This could be a wealthy merchant or a peasant on church land. A peasant family lived together in a simple cottage that was essentially a small house created from any accessible building materials. For example, wood, clay and straw were readily available in England during the Medieval Era and most cottages were made of some combination of these materials. These houses were fairly easy to construct and repair. The family would cook and sew clothing in these self-built homes.

On every day but Sunday, peasants would tend to their fields or perform any other special job they might have. The fields were long strips of open land. Peasants would pay the lord his due by giving him a portion of the crops they produced or by working the lord's strips of land as well as toiling on their own. Peasants were not usually allowed to leave the manor of the lord. On Sunday, however, they attended mass at the church presided over by the local priest.

This sort of agricultural life was expected of a peasant. If you were born a peasant, you basically were confined to this low status for life. It was, however, not impossible to improve your station. An intelligent peasant might be allowed to study to become a clergyman, or perhaps be selected to serve as a squire and train as a soldier. An extremely fortunate peasant might actually become a knight; this was rare but did occur when a lord had no sons that lived to adulthood and a vassal performed extraordinary service for him on the manor or on the battlefield.

While most peasants were farmers, they were not all tied to the land. Craftsmen of various types could be found in abundance in the towns and some were on the manors.

These were men who passed their skills from father to son, or by apprenticeship. They made many goods that people needed but could not supply themselves. Blacksmiths who were one of the more distributed tradesmen - you might find one a manor, in a village or in a town - would work iron. Other craftsman worked for the export market - which in Europe was typically fine cloth, such as linen and lace, which was durable in transit, not too heavy, and in demand by the nobility who found the material impressive. Specialists worked on vineyards making the wine which people drank by the cask. This was specialized by region - as the lands and climate had to be right to reach export quality. Beer was less limited to the sunny climates. The armorers pushing the state of the art in ironwork from wrought iron to steel were also typically located in the towns. A fair number would be part of the lord's regular staff and go on campaign with the troops to do repairs and maintenance beyond that which the squires and other servants could do.

There were many other possible crafts that a commoner could be skilled in besides farming but a small portion of the population did these things. Rather than craftsmen, however, it was the traveling bards, peddlers, and merchants based in the towns that brought social and economic change to Medieval Europe over time. It was an alliance of the walled towns and the monarchs against the local nobility that brought down the land based economy controlled by the vassals.

What did the towns want? They wanted centralized government to bring a rule of law to the land to allow safe trade and enforce contracts, build roads, and police highways. In return they would pay taxes to the monarch - money that did not come from the land - yet allowed the king to raise an army or navy of his own and take back control from the Barons or invade neighboring kingdoms by land or by sea. Clearing the sea of

pirates and smugglers was as important to the town-based merchants and bankers as patrolling the highways. Depending on the town, it could be more important. Travel by water was the easiest way to move cargoes especially those prone to breakage in wagons that jolted over the roads with no springs to cushion the cargo. Pottery is a good example of what traveled by water if possible and with the construction of canals that was possible in much of Europe.

Economics, and Government:

Having described each estate, we can see how they intertwine and interact to give us the necessary elements of a society: economics, social order, and government. The modernization of Europe is largely the story of the rise of part of the third estate to power.

The above description of the estate's introduced us to some factors that make up medieval European society. In terms of education, the society was largely illiterate with the exception of the learned clergy and part of the nobility and merchant classes. Few others, including members of nobility, were educated or literate. Thus, any books or written accounts that came from that period tended to be authored by clergymen, and most likely by the monks.

In terms of leisurely pursuits, the medieval society was far more advanced. It was not a fast paced, highly productive society in terms of material goods, but festivals would often be held and the peasants would gather and celebrate the various seasons (like the reaping of a good harvest). Nobles especially enjoyed celebrations, specifically one's that included a lively jousting competition and dancing – true courtly arts. They would banquet with visiting nobility and engage in feasting, drinking, and the enjoyment of assorted entertainment (bards, puppeteers, musicians, jesters, etc.).

There was one factor that united the three very different estates and that was their belief in God. The king, the lords, and the peasants alike feared God's wrath and sought to avoid damnation. Thus tithing was given without question to the church every year. This unconditional support of the church in terms of money and faith empowered it. The church also inherited land from families without an heir – a living son. Since the clergy could not lose the land the same way, every time they accumulated property from the faithful the church could keep in perpetuity. In addition to freely given tithes, the people embraced whatever the Church introduced as God's will. This is evident by voluntary participation in the Crusades; the holy wars the church conducted in order to defeat the heathen Moors in Spain and the Holy-land, or snuff out a local heresy.

Both the church and the lords had governmental means for punishing those who had committed offenses. The church had the Canon law to govern breaches and disputes over wedding and inheritance issues so their rule was relatively consistent from case to case. The lords on the other hand were at liberty to punish their serfs as they saw appropriate. This was called the manor court. The lord could kill an errant serf if he chose, but he rarely did because it would only reduce the manor's productivity to kill someone who worked the land. Instead, the lord would usually impose fines or penalties upon the serf. The penalties could indeed be cruel, like the blinding of one eye or the removal of a finger. The lord would now retain his work force, but insure the fearful loyalty of the serfs; one was made an example of to others. This form of justice was perfectly acceptable at the time since the serf was attached to the land and the master owned the land.

The only way a serf could escape his “master” was to “disappear” for 7 years, after which the master’s claim on him would lapse. The men at arms for foreign campaigns, traveling entertainers and ship crews as well as labor force of the towns tended to come from this source – the runaway serf. Some of them also worked the land at monasteries for 7 years. Note that this meant abandoning friends, family, wives, and children who one could not take with you to be an outlaw. This is not something lightly done.

In Germany there was a saying “City air makes men free” which would seem odd out of context. Cities and towns of the period were quite dangerous places due to abusive labor practices and rampant disease due to unsanitary conditions. Still people flocked there from the land. You can see why. Seven years, the normal length of an apprenticeship to learn a trade, was the magic number for starting a new life as a free tradesman or craftsmen – as long as the lord and his henchmen could be kept out of the town. Towns had walls, watchmen, and guards. They counter balanced the power of local lords – and monarchs found that useful, extending them charters to keep them loyal to the king, not the local nobility. They too could raise an army – and more, they could equip it. However, they could not grow food.

When discussing the place of the nobles in society and culture, one is quick to notice knights and chivalry. The code of chivalry shared by the knights was a set of special courtesies that they extended to each other as equals in the nobility. It was also a guideline set as to how knights should act in general. They were supposed to remain courteous at all times and only fight for good and just purposes. The church also had a vested interest in the behavior of knights because the church believed that it had a duty to

make sure people didn't go to war for less than noble causes. In order to reduce the chances that the knights would fight among themselves; the church sent them to war against the "heathen" peoples of other religions and honored holy days with truces and mercy toward non-combatants. In return, a priest would appeal to God to bless the arms and protect his loyal servants as they go to war in his name, and administer last rights to the fallen.

It was mentioned earlier that the king was the most powerful member of the feudal hierarchy, with the understanding that vassals were generally unruly and jealous and could be treacherous. The king was only powerful as long as the oaths of loyalty taken by his vassals were "sincere" (and that meant enforceable). If the oaths were ignored and the king could not deploy a great number of knights to enforce them, he would actually be fairly weak. Throughout history, it is seen that it was not uncommon for a king's power to be overshadowed by that of a powerful and wealthy lord, normally his vassal. Rights had to be backed by power and hence the king often had to ask one vassal considered loyal to put down another considered disloyal. A "loyal" enforcer with a record of success could then become very powerful - literally a rival for control of the kingdom. One did not want to request this service too often if one hoped to keep one's crown.

In terms of economy, the medieval era was clearly agrarian in nature. Farmers fed themselves, the specialists (such as blacksmiths) their lords, and the clergy. Payment was given and taken in food or livestock items, much like a barter system most of the time. As skilled craftsmen improved their trades and their wares became more popular, they began to be in demand outside of their home manor. An example of this is the Flemish,

who took wool and turned into finely woven and intricate lace patterns. Flemish lace rapidly became an export item, with demand outside of its region. This spawned two developments: currency and merchants. Currency had existed during ancient times, but the barter-like nature of medieval transactions made it less necessary while trade was local. However, instead of receiving payment in food or grain, lords began to request coinage from their serfs so that they might purchase foreign trade goods ranging from spices to fine metalwork. Thus, needlework, tools and food needed to be taken to town and sold to pay one's rent.

The conversion of goods into money rents at a fixed traditional price seemed to favor the landlords. However, that did not end up being the case due to inflation. As the price of goods rose over time and the value of the rents was fixed by tradition, the rents became cheaper in terms of goods and the goods the lord wanted became increasingly dear. The result was money impoverished and struggling nobles with titles but little wealth or power. Indeed, some of their tenants became better off than they were and tried to buy the land they worked from the Lord. Some succeeded.

Meanwhile, people in towns who facilitated trading by importation and purchasing rare goods were known as merchants. This merchant class was able to acquire a great deal of wealth by this new venue of being middlemen in trading. The arrival of this new class complicated the simple feudal system. Merchants had money and were favored by the nobility for the goods that they provided. However, they had no land or title and were clearly not part of the noble class. Being neither peasant nor nobility and certainly not part of the clergy, the merchants eventually broke down many of the feudal system's social barriers, by buying titles from impoverished nobles or marrying into their

families, or buying the land itself. Social mobility entered the European Estate System by the back door as wealth; status and power were again united for a time by marriage of Lords with titles to the children of merchants.

XV. LAW AT WILL: LEGALITY BASED UPON A LORD'S DISCRETION

You may at this point be wondering how is it that justice was carried out in the Middle Ages. Who were the police? Who made up the court system? Who made the laws? Laws were directly related to your "Estate" in the Middle Ages. The king was traditionally the most powerful member of the feudal hierarchy and ruled over the entire realm or secular (non-church) kingdom. The important thing was that he could rule the first estate, and provide a place to appeal the abuse of the third estate people by the local nobles. He issued "edicts", laws by decree laws that governed everyone, but there were also local edicts made the lords of individual manors. People had to follow both the local and general laws of their region.

If you ignored an edit (broke a law), it was up to the local lord to judge you. This was pretty common since the laws were constantly changing and not always written down, varying by manor or even when a new lord took over. There were no formal juries like today; instead, the lord could do as he pleased with a serf. Of course, if it was someone else's serf the matter became more complicated depending on relations between the lords. If the lord thought you should go free then you would be released. In turn, the king could in theory punish his lord, as he saw fit but actually might lack the power to enforce his will, as noted earlier.

Let us look at an example of this. Say your classroom was a village, your teacher being the lord and your principal is the king. Now let's say that you were misbehaving in class; in the middle ages your teacher could have punished you in any way they felt like at the time. One day, Joe talks in class. The "lord" is in a good mood and just throws an eraser at him. Remember, if they didn't have a law that dealt with your bad behavior (or even if they did), the lord could make one up on the spot, so it need not be fair or consistent. The next day if you talked in class the teacher could have you flogged with a whip, have your tongue cut off or have you hung upside down by your feet in the cafeteria at lunch time and let everyone else throw food at you. The next time you did it, you could be told "the rope would be around your neck". If this was the case, I don't think any of you would talk during class unless you were "buddy, buddy" with the lord. The principal could do the same to anyone in the school including teachers, janitors, and lunch ladies.

What is the problem with this system?

Abuse of power and unfairness is the main issue here. The lord may not personally like the accused and therefore would not be fair in judging him or her to let the punishment fit the crime. Lords didn't care much about the peasants, so any arguments on behalf of the peasant would often fall on deaf ears since they were more interested in making an example of the accused to intimidate others than to balance the scales of justice in any abstract sense. Some lords openly terrorized the populace to control it. Further, false accusations could be considered true if the lord did not believe you or care to look into the matter if he didn't like you, or did like the other guy. There is one similarity between law today and then. We too have a regional hierarchy of jurisdiction.

The lords were like governors and the king was like the president. We are governed by both state and federal laws, which is similar to their system. They did not have courts or formal police or due process though, so the similarities in formulation and application of the law are few.

XVI. THE CASTLE

This unit covers the evolution of castles. What is the advantage of having a castle? How does the castle stand up? For whom was the castle built? What was life like in a castle? Illustrations of castles during different stages of being built will be used to aid in learning about the castles.

The castle was the result of trying to build a home for a noble or a king that could provide some defense against enemies. It was a place where you did not have to wear armor. Castles did not start out as great structures with large stone walls and towers. Castles evolved from fortresses. Fortresses were wooden structures built for protection. They would have a main building and a large wooden wall around it, sometimes with towers along the walls for archers. It provided some defense but it had many weaknesses. First, wood is relatively soft and can be cut through with a metal ax. For this reason, the walls could be damaged very easily. Second and probably most importantly, wood burns. This causes a real problem when all your enemy has to do is light a fire to destroy your fortress. The advantage of a fortress is that it can be built very quickly. It would only take a couple of months to complete the erection of a fortress.

The weakness and flammability of the fortress walls could be overcome if they were built with stone stacked in front of it. The wooden wall behind the stones would be the support and the stones' the protection. This is great for defense, but it takes time to mine and cut the stone for the wall and the rough surface of a pile of quarried stone is not too hard to climb. This could extend the time to build a fortress by many months. However, the more fortresses that were built the more medieval people learned about their construction. Purely stone walls would soon replace the reinforced wooden walls. These were much stronger than the wooden ones, there was a trade off as the time, and cost of construction was greatly extended. Still, on this foundation of knowledge the birth of the great stone fortresses known as castles emerged.

A small castle would take years to build. Each stone had to be mined and cut to size. It then had to be transported to the building site and be put into place. Castles were made of thousands of stone blocks that all had to be cut by hand. Remember that there were no cars or trucks to move the stones. Also, there were no cranes to lift the stone to the top of the walls. Stone was lifted to the higher points of the castle by pulleys. These stones weighed hundreds of pounds each. As you can imagine this was hard, work and it took a while. In addition, in order to stand up, a wall had to be thicker at the bottom than it was at the top. The wall was actually made as two stone sidewalls that were filled with dirt and debris left over from all the building and cutting. It was not solid stone. Again this process would take years to complete and some castles would even take ten to twenty years to build. That is a long time to wait for a home. If you were building a castle you were a king or a noble and you had a lot of money or labor that you could support to do their task. Not everyone could afford a castle.

Once they were built, who lived in a castle? First off, there was the noble or king who owned it. He, his wife, and family lived in the main house in the castle, away from the great hall and the servants quarters. Next were the servants. They lived in the servants quarters near the courtyard or in their own houses away from the castle. They did all the cooking and cleaning. At any time, many visitors stayed in the great hall along with many animals stabled there. There were dogs and cats and the hall was lined with hay. These animals were not house-trained and did their business upon the available hay. Feasts would be held in the great hall. When eating, people would just throw their scraps to the floor for the animals to eat. Whatever the animals did not feed on simply remained to rot upon the floor. Therefore, as you can gather, it was not very clean in the hall or in the castle itself. The hall was only cleaned out five or six times a year! It did not smell very nice in there as well as being filthy.

There would also be a fire in the middle of the great hall. This accounts for the ceilings being so high. Vent holes in the roof had to be very small so not to let in rain or snow and all of the windows in castles were small as well for defense reasons. The ceiling was high so the smoke that would collect in the top of the hall would not be down at the level of the people and animals trying to breathe. This added to the smell and the unsanitary conditions of castle life. Life in the castle was not as it is portrayed in movies, but in fact a dirty and demanding life. However, for its time the castle was a significant technological advancement that the wealthy and powerful wanted to provide some protection in turbulent times. When law and order were tenuous, they needed a secure base from which to extend their control. Rules of hospitality also meant that travelers could get shelter for a night within the walls-or possibly camped under them.

SECTION FIVE (Conclusion)

XVIII. TECHNOLOGICAL ADVANCE: THE INVENTION OF THE GUN

Warfare in the era of armor was a very different experience for the noble knight and the common man at arms. However, a new invention began to threaten the advantage that armor gave, making its weight and cost disadvantages an increasingly questionable trade-off. What new weapon came about and made suits of armor useless? The discovery and use of gunpowder was the main cause.

First to be introduced was the cannon shooting iron balls to batter down stone walls from a distance. Small hand-held “cannons” for use against armor soon followed. Bullets could shoot through the armor that was made to stop swords and blunt attacks. Hence, armor blacksmiths were forced to make stronger and thicker plates of armor. This heavier armor was able to stop bullets in the beginning, but as bullets and gunpowder improved and became more accurate, the armor became heavier, clumsier and thus less and less useful. Another advantage of gunpowder was the simplicity of the gun. A well-trained longbowman could fire an arrow through a weak spot or chink in armor, but it was a slow process to master the bow to that degree. It took years of practice before a bowman had sufficient skill and aim to be effective. This was not the case with a gun. With a short tutorial, virtually anyone could successfully attack and pierce a suit of armor. Eventually, it didn't make sense to wear heavy, bulky suits of armor since a bullet could shoot through it anyway.

This has been essentially the progression of arms in response to superior armor. While it plays a strong role in the history of the period, it is not the entire story. Nobles, in addition to wearing armor and using swords would also typically fight on horseback. Unmounted soldiers were little match for charging cavalry with lances. Thus, in the event of a peasant uprising, where a group of well-equipped mounted soldiers would go up against a larger group of poorly outfitted peasants, they would almost always win. The Swiss footsoldiers - freemen defending their ground by gathering into mountain passes used a type of weapon called a pike to stop a cavalry charge. A pike was essentially a long shaft with a bladed end. A group of soldiers all carrying these weapons stood together like a wall, impenetrable to cavalry charges, since any horse and men that rode into these blades was bound to be injured or killed. Thus, we have a case of a technology rendering the previously optimum type of attack useless.

In investigating this example of an escalating arms race, we see that change occurs far beyond the battlefield. Since peasants can easily make these pikes, the lords have cause to worry, as their supremacy is no longer unchallenged. They begin to strengthen their castles; they must also invest in additional foot soldier troops to contend with these pikemen, as they simply can't run down foot soldiers anymore.

This type of combat which contained all the honor and tradition of the nobility was squashed by merely putting a blade at the end of a long stick. This is the power of an idea in an arms race. Things that have been held to be true and constant for hundreds of years can become obsolete due to an innovation and whole nations and industries can be thrown into confusion and then changed forever. The seesaw of offenses designed to overcome existing defenses goes on and on – but the chapter involving the metal workers

quest for a sharper, harder, stronger blade and its adaptation into the iron and steel skin we call armor is a classic example of an arms race involving incremental improvements that brought a technology to “perfection”, its logical conclusion and then its overthrow by another technology that would go through its own cycle of improvement. Further, the race between the armorer and the weapons maker went on long enough to allow us to see an evolution of perfecting of design and technology within a state of art that helps one understand the process involved. It is harder to observe the competitive drive to incremental improvement by trial and error in the faster paced more complex current period, but the same sorts of things are going on.