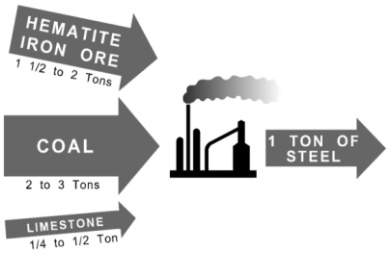
Blast furnaces were the most common way to make iron and steel in this time.



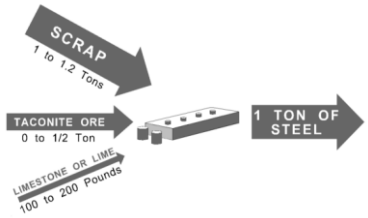
A blast furnace is a tall metal cylinder with openings to
1. put raw materials in,
2. blow air in (the "blast"),
3. remove impurities, and
4. take the liquid metal out.

A blast furnace can make a ton of steel out of three tons of coal, two tons of iron ore, and half a ton of limestone. Limestone can be found in many places around the world. Only a few places have good deposits of coal or iron.

Because a blast furnace is expensive to build, it has to run 24 hours a day. It makes a huge amount of steel, so it should not be too far from customers. In this time, the biggest users of steel were people who build railroads, bridges, and large buildings.

When do you think this was: 1790s, 1890s, or 1990s? Why?

Electric-arc furnaces were the most common way to make steel in this time.



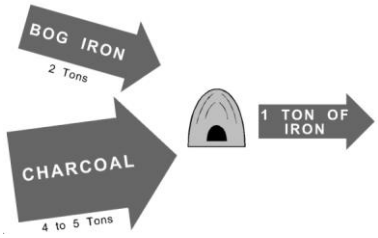
An electric-arc furnace can make a ton of steel out of two tons of scrap iron (sheet-steel trimmings and old cars) and taconite (pellets made from low-grade iron ore).

An electric furnace makes less than a blast furnace, but more than a charcoal oven. It needs a reliable supply of cheap electricity. This can come from coal-fired generators, hydroelectric dams, nuclear reactors, etc.

An electric furnace can make different alloys (mixtures of metals) for special uses. It needs fewer workers than a blast furnace, but they must be able to follow complex procedures. In this time, the main uses of steel were in buildings, automobiles, and home appliances like stoves or refrigerators. These things were made in many places.

When do you think this was: 1790s, 1890s, or 1990s? Why?

Charcoal ovens were the most common way to make iron and steel in this time.



A charcoal oven can make a ton of iron out of about two tons of bog iron ore and four to five tons of charcoal (made from about 5-7 tons of trees, preferably pine).

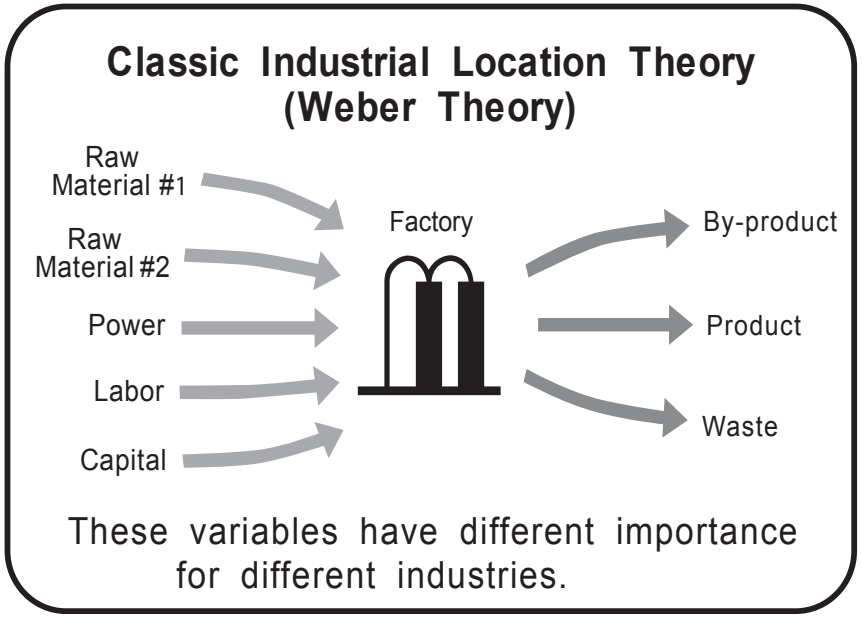
If you have ever picked up a recently cut pine log, you know the wood has a lot of sticky sap in it. The logs must be heated in ovens to drive out the sticky resins and leave charcoal, which is nearly pure carbon.

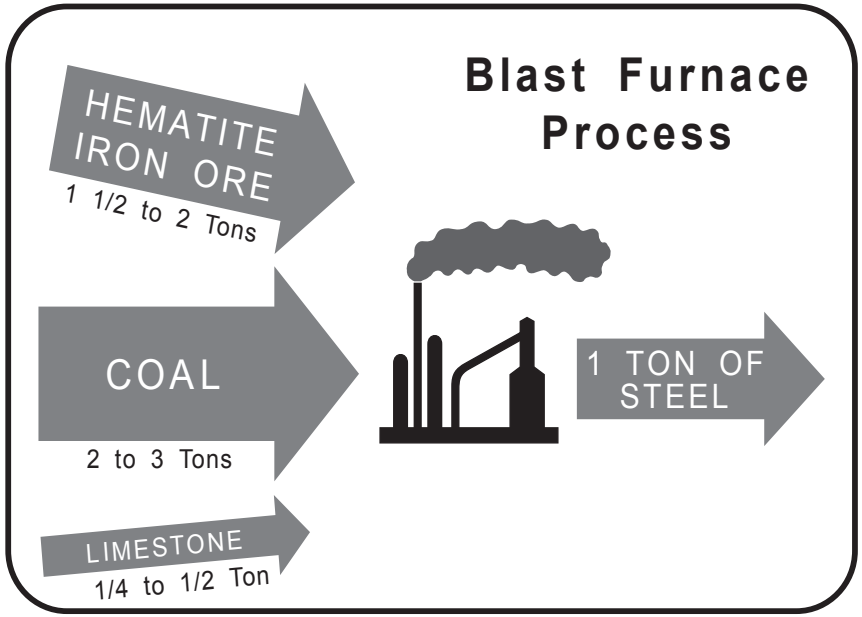
Charcoal ovens are usually small, because a big oven would soon consume all the trees near the factory.

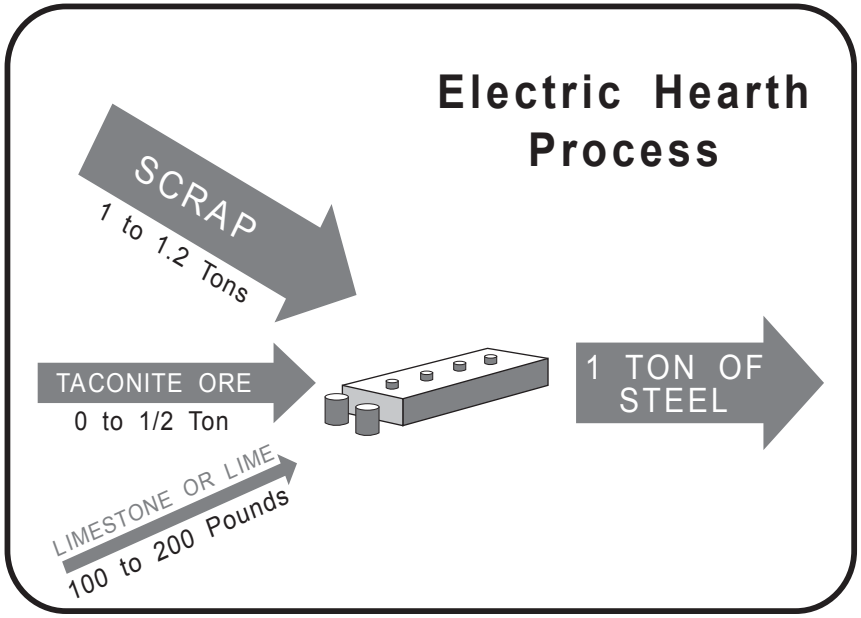
In this time, the major uses of iron were for wagon wheels, guns, tools, and things like nails and door hinges. Many things can be forged in a small blacksmith shop. A blacksmith must be strong enough to use a heavy hammer all day long!

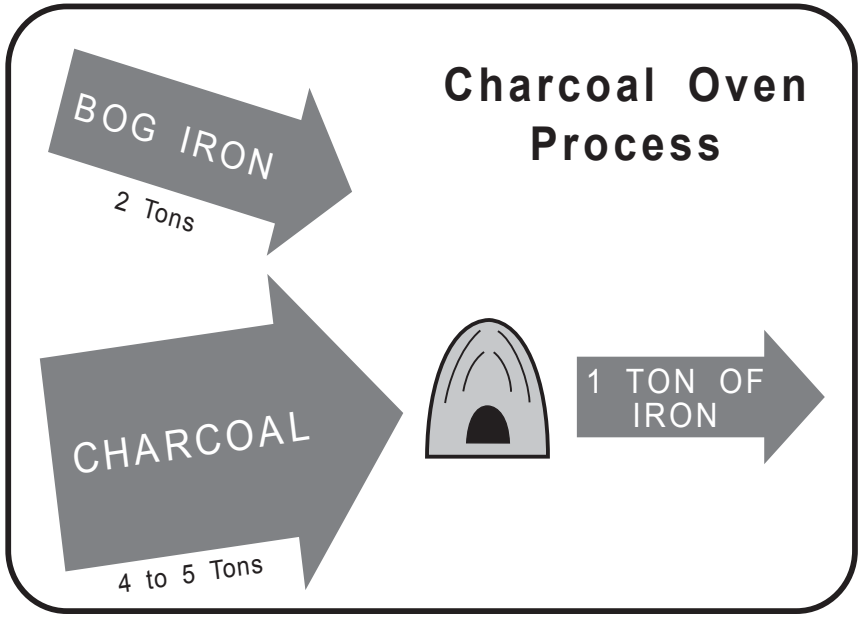
When do you think this was: 1790s, 1890s, or 1990s? Why?

Input/output diagrams for various iron technologies









Source: adapted from material later published in ARGUS, 1996.

Locational considerations for an iron/steel factory

What kinds of places were likely to grow or decline in each time period?

Mark the ovals that identify the considerations that would be important at each time. On the line, write a phrase to indicate what kind of location you might choose based on this knowledge (IF you think it is important - not all of them are!). For example, you might put a factory near a forest if charcoal is a main source of energy.

	1790s	1890s	1990s	where would you put factory?
Source of energy				
Solar power	○	○	●	a sunny place
Charcoal	●	○	○	inside or near pine woods
Bituminous coal	○	○	○	
Hydroelectric dam	○	○	○	
Nuclear reactor	○	○	○	
Source of iron				
Bog iron ore	○	○	○	
Hematite - hi grade ore	○	○	○	
Taconite - low grade ore	○	○	○	
Scrap iron	○	○	○	

Note: taconite is a way to process low-grade hematite into pellets that are good for steel-making.

Mode of transportation				
Horse cart	●	○	○	not big influence on factory location
Canal boat	○	○	○	
Railroad	○	○	○	
Highway truck	○	○	○	
Workers needed				
Treecutters	○	○	○	
Bog iron haulers	○	○	○	
Ore miners	○	○	○	
Railroad engineers	○	○	○	
Furnace loaders	○	○	○	
Computer operators	○	○	○	
Major users of iron or steel				
Military weapons	○	○	○	
Wagon wheels	○	○	○	
Nails and hinges	○	○	○	
Railroad rails	○	○	○	
Home appliances	○	○	○	
Tall buildings	○	●	●	close to large city

On a separate piece of paper, write a recommendation to a factory board of directors, explaining what kind of location would be good for an iron/steel factory at a given time.

RESPONSE SHEET – IRON AND STEEL Name _____

1) Choose two locations for iron-making factories in the late 1700s.
Try to put each factory close to population centers and sources of the heaviest raw materials that were needed by the iron-making technology of the time.

Write the letters of the locations you recommend for the factories: __ and __
Why did you choose those locations?

2) By the late 1800s, iron-making technology had changed. Choose three locations on the map for factories at this time. Try to put each factory where it can easily transport all the materials needed by the iron-making technology of the time.

Write the letters of the three locations you recommend: __, __, and __
Why did you choose those locations?

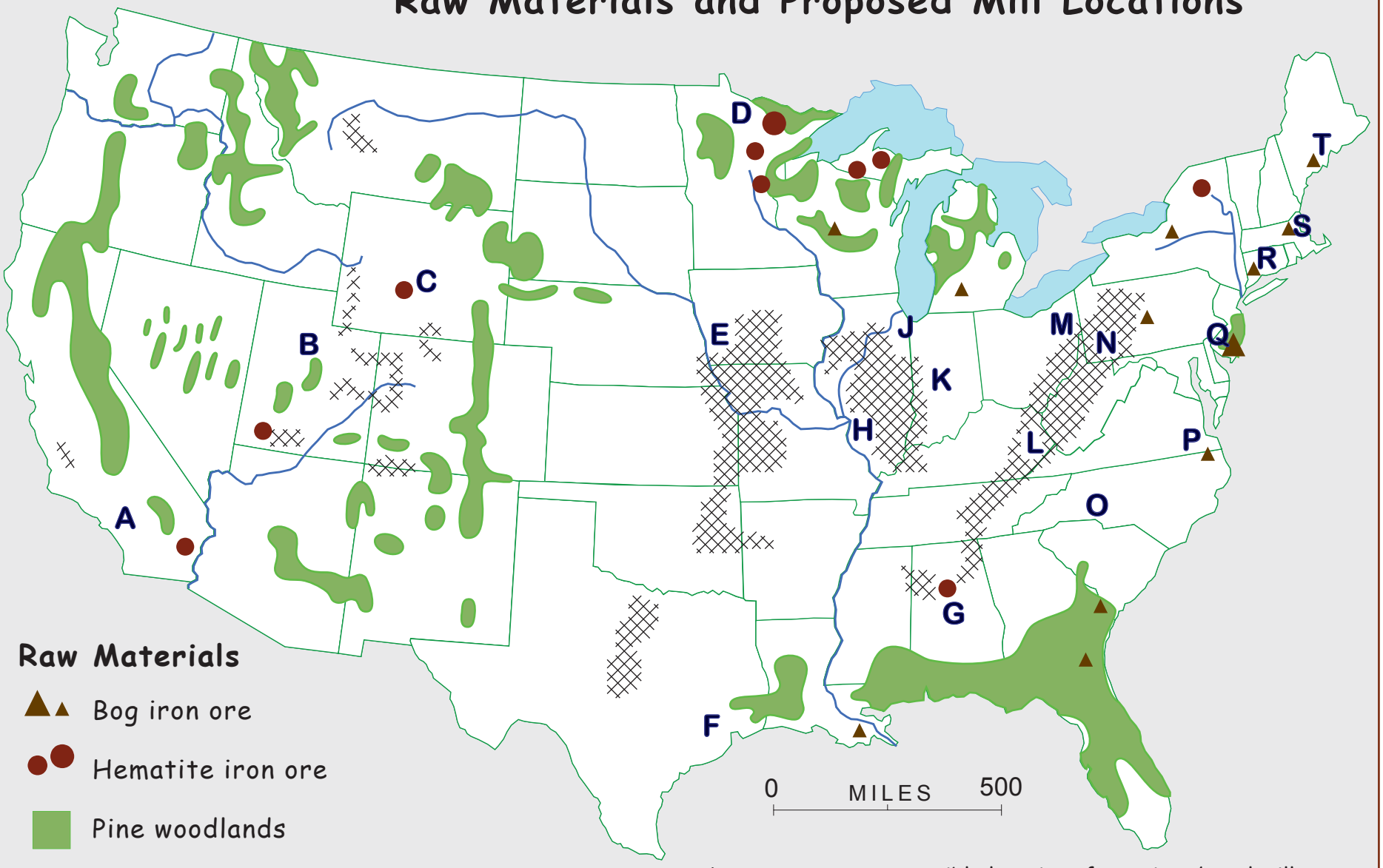
3) If you decided to close a factory at a location that you chose in question 1, write its letter here __. Why did you decide to close the factory at that location?

4) By the late 1900s, iron-making technology had changed again. Choose four map locations for factories. Try to put each factory where it can easily transport the heaviest raw materials that are needed by modern iron-making technology.

Write the letters of the four locations you recommend: __, __, __, and __
Why did you choose those locations?

5) Write the letter of any location that you chose in question 2, but have decided to close the factory rather than keep it running: ____
Why did you decide to abandon the factory at that location?

Iron Production Technologies: Raw Materials and Proposed Mill Locations



Letters represent possible locations for an iron/steel mill.
Where would you put factories in 1790? in 1890? in 1990?

Steel-Making in Europe

Iron-making was "invented" by the Hittites about 1500 BCE.

For more than 3000 years, people used **charcoal ovens** to make iron. These ovens used about 5 tons of wood (made into charcoal) and 2 tons of bog iron ore to make one ton of iron.

Bog iron ore was especially common where glaciers made swampy land in northern Europe.

Then, in the 1800s, people invented **blast furnaces** - a better way to make iron. These huge machines used about 1-1/2 tons of iron ore and 3 tons of coal to make 1 ton of steel.

Blast furnaces are big, complicated, and very expensive, but they make better steel with less input material. They also work better in different locations than charcoal ovens.

Rank these locations as Good, OK, or Bad as sites for blast furnaces in the late 1800s.

	Rank	Comment
1. Reykjavik, Iceland	B	too far, no iron or coal
2. Kiruna, Sweden		
3. Midlands, England		
4. Paris, France		
5. Rhineland, Germany		
6. Silesia, Poland		
7. Donbas, Ukraine		
8. Bilbao, Spain		
9. Venice, Italy		
10. Danube River		