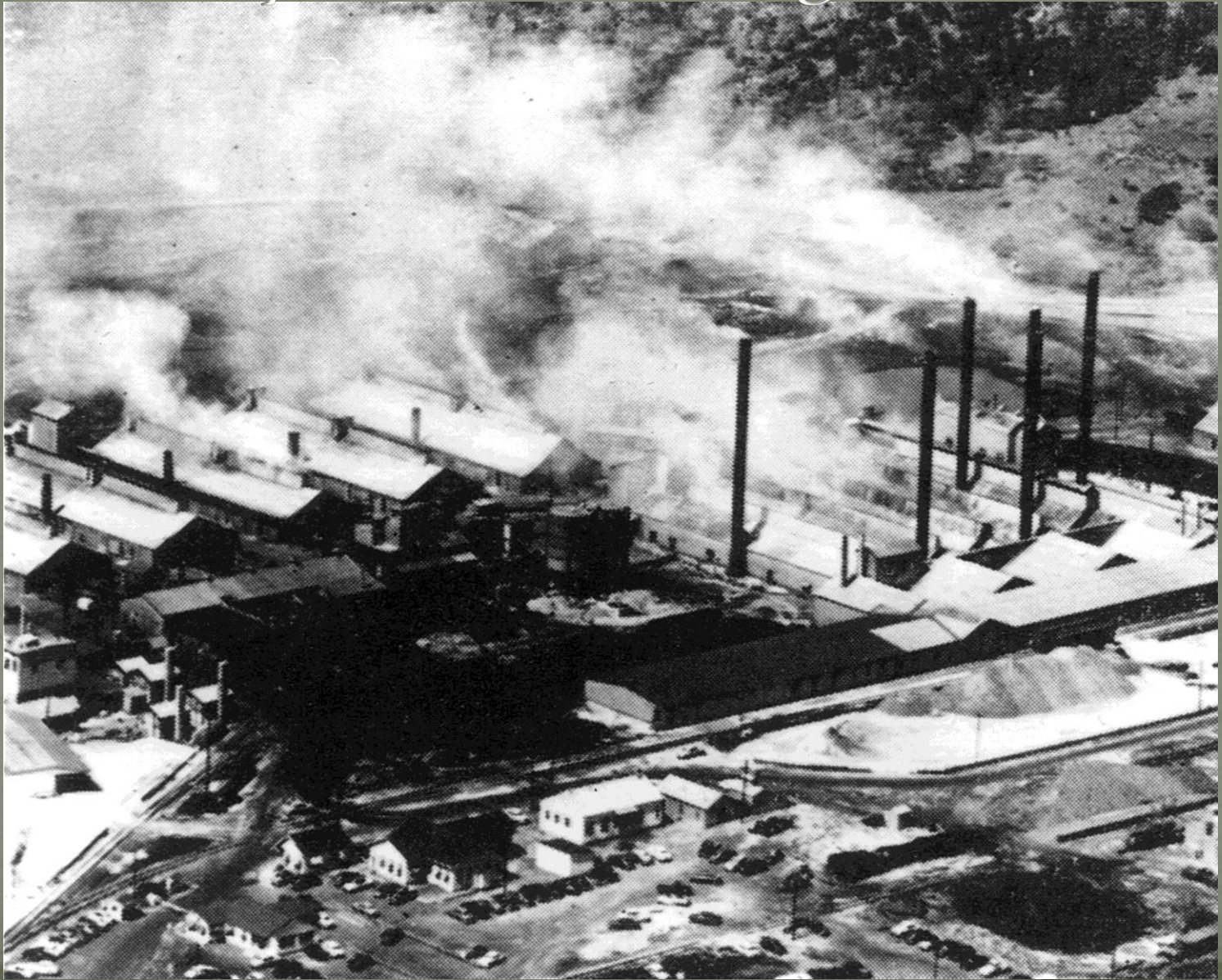


The History of Zinc Smelting in Oklahoma



Recovery of Zinc through distillation

- China – beginning of the 15th Century
 - Fired ore and charcoal in clay crucibles with necks that cooled and condensed the zinc vapor
 - 15th Century Chinese zinc coins



Horizontal Retort Smelting

- Developed in Belgium in 1789
- Responsible for 90% of zinc production until 1917, when the electrolytic process was introduced
- The major type of smelter in Oklahoma
- Drawbacks
 - Labor intensive
 - High operating costs (energy, waste)
 - Poor zinc recovery
 - Large volume of atmospheric pollution (acid, heavy metals)
 - Large volume of solid/hazardous waste

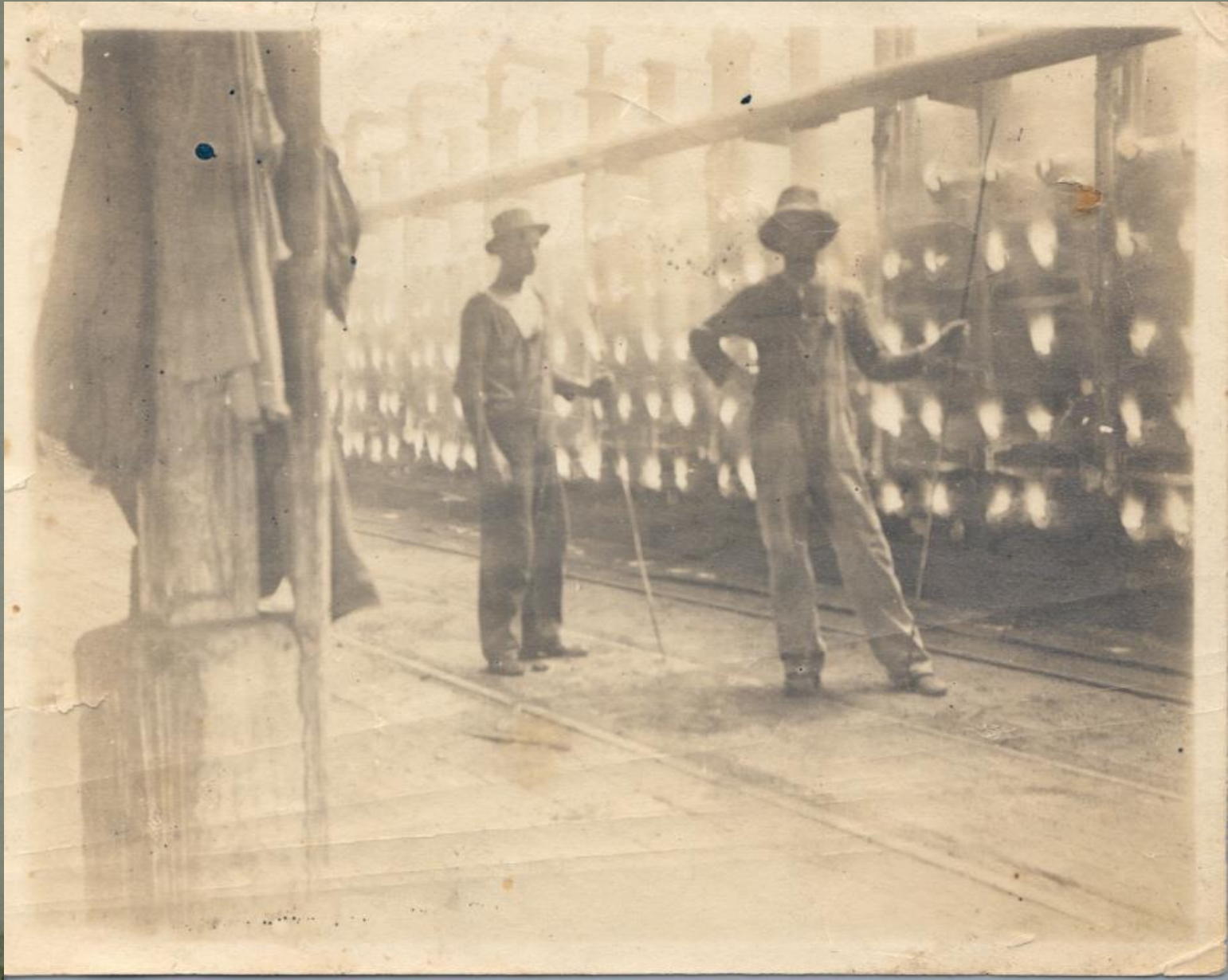
Distillation of Zinc

- Zinc occurs naturally as zinc sulfide – a fairly inert substance
- The ore has to be processed before the zinc metal can be recovered
 - Ore is milled, upgraded and concentrated (Beneficiation)
 - Ore is heated in oxygen to convert zinc sulfide to zinc oxide (Roasting)
 - Roasted ore is mixed with blue powder, coal and silica and burned
 - The resulting “clinker” or “sinter cake” is crushed and the “charge” is placed in the retort and then into the furnace
- Zinc volatilizes from the charge at 907°C

Federated Metals, Sand Springs



Zinc Smelters employee about 600 men.



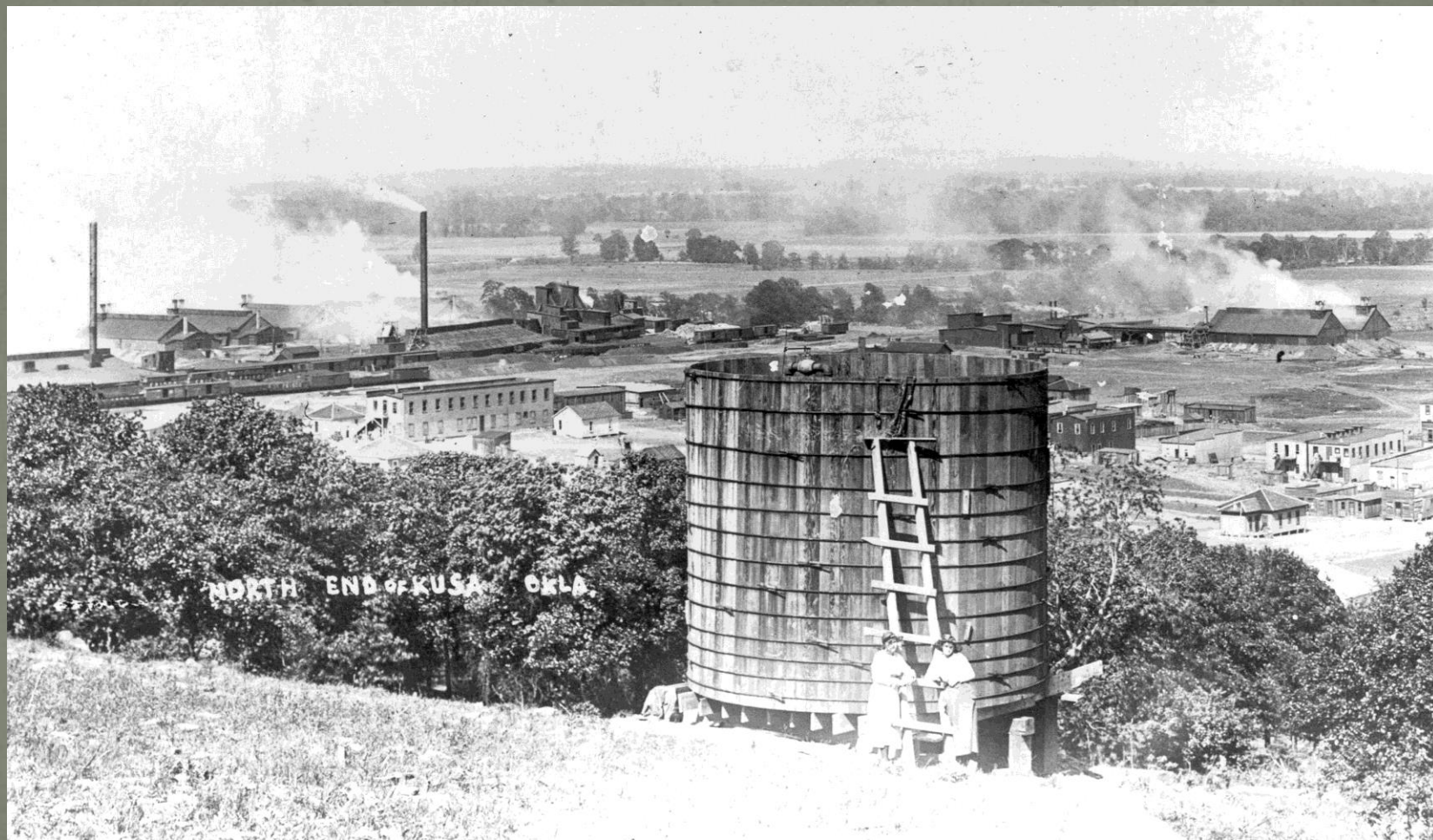
Smelters in Oklahoma

- In the 1900s, many horizontal zinc smelters were built in Oklahoma due to:
 - Easy access to coal used in zinc reduction
 - Zinc bearing ore from the Tri-State Mining District
 - Access to fireclay
 - Cheap, abundant natural gas to fire the furnaces
 - Most smelters drilled their own, on-site gas wells
 - As early as 1914, smelters began to doubt whether the gas fields would sustain their business
 - By the 1950s, at least one of the remaining smelters had to purchase natural gas from Texas.

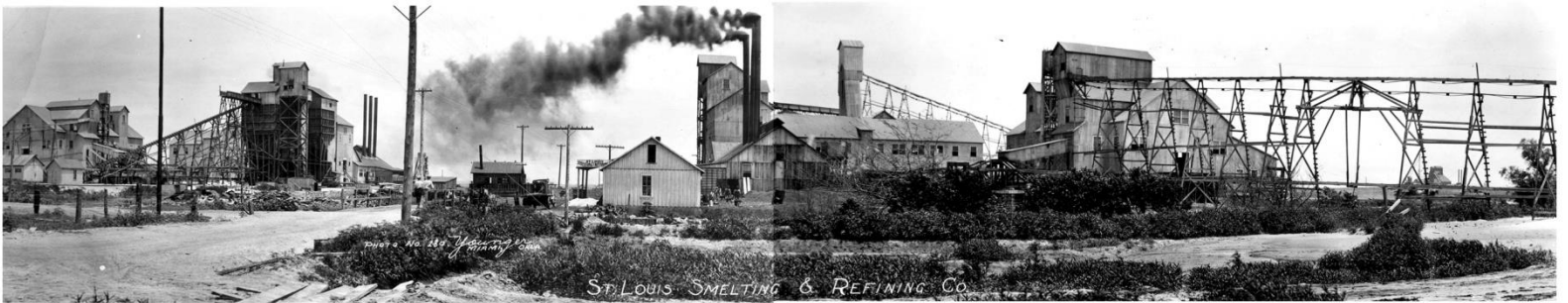
Smelter Towns

- Bartlesville – three smelters
- Blackwell – one smelter
- Checotah – one smelter
- Collinsville – two smelters
- Henryetta – three smelters
- Kusa/Dewar – three smelters (quickly combined into one)
- Muskogee – one smelter
- Picher – one smelter
- Total of 15 smelter sites.

KUSA Smelter, Dewar



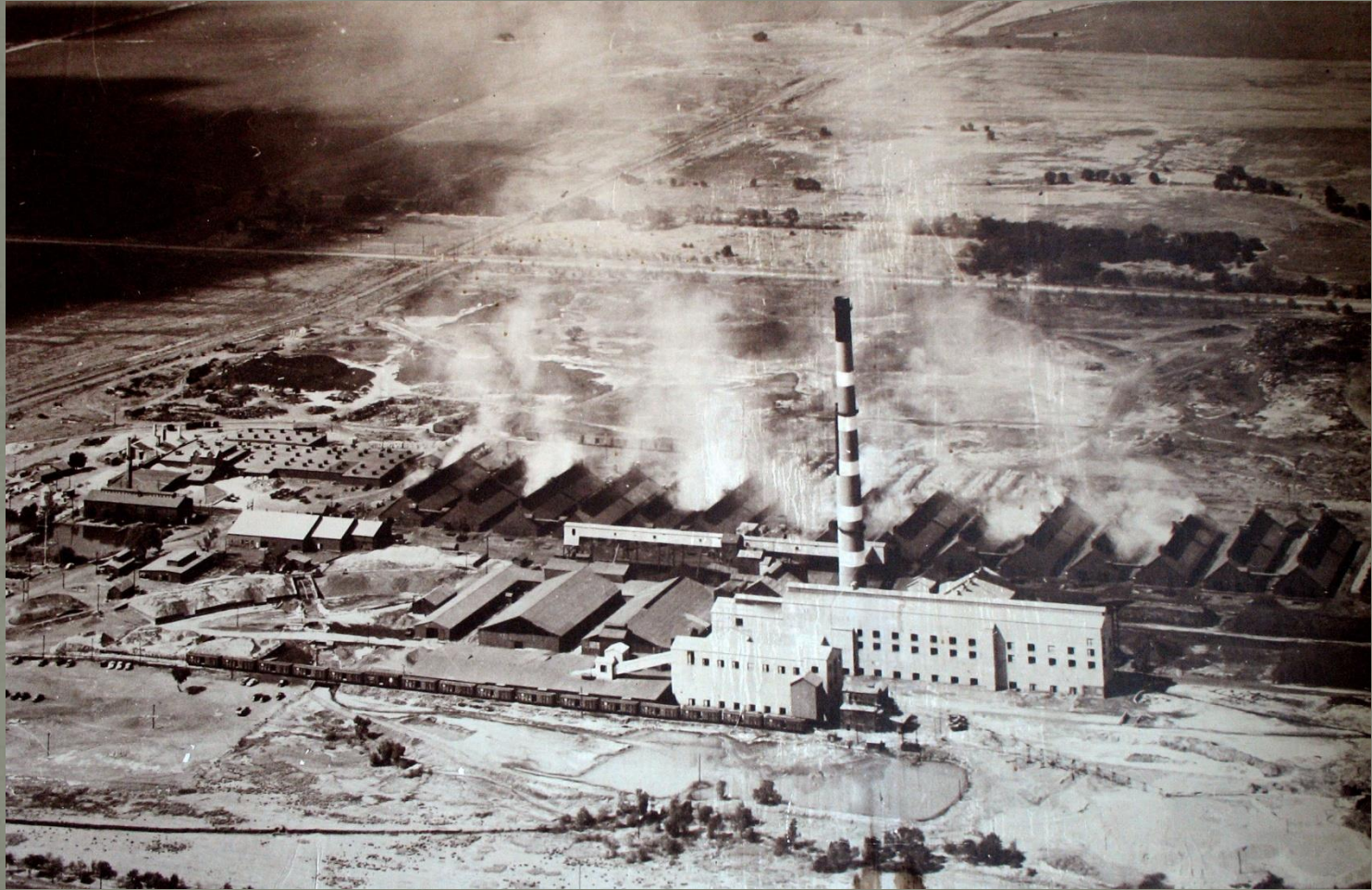
St. Louis - Ontario Smelter, Picher, Oklahoma



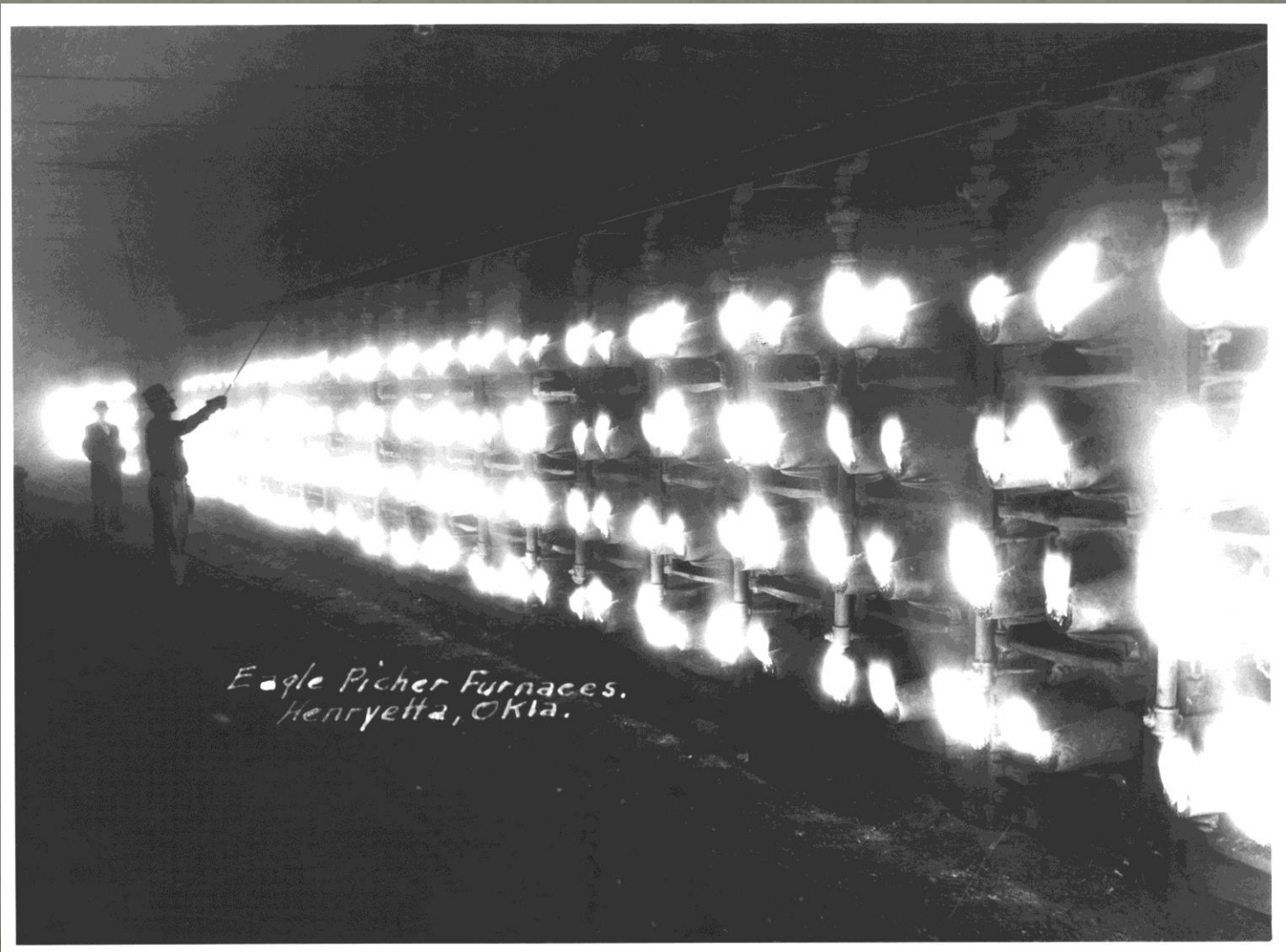
Collinsville Smelter



Blackwell Smelter



Firing the charge.



Labor Intensive – everything was manual



Mules were used to haul ore and slag to and from the smelter



World War I

- Smelters increased their capacity
- New smelters were built
- Heavy war time demand for zinc
 - Armaments were galvanized with zinc to prevent corrosion
- After the war, capacity far exceeded demand and many smelters closed.
- Three smelters in Oklahoma operated into the 1950s and beyond
 - Bartlesville
 - Blackwell
 - Henryetta

The Environmental Legacy

- Miles of dead vegetation from the deposition of metal laden acidic air emissions
- Tons of hazardous waste on land where nothing grows
 - Retorts routinely broke (average lifespan 40 days)
 - Fired clay vessels
 - Condensers lasted less than a week
 - Retorts were pulverized to make “conny sand”
 - Condensers were 62% retort fragments
 - Slag
 - The material left in the retort after the zinc is volatilized
 - Contained high concentrations of heavy metals
 - Notably, lead, cadmium, arsenic, and zinc

KUSA, Dewar, Oklahoma



Federated Metals, Sand Springs, OK



Henryetta Smelter



KUSA



KUSA



Checotah



Tulsa Fuel and Manufacturing



Used Retorts used as building materials (dams, fences, etc.)



Tulsa Fuel and Manufacturing, Collinsville



The inside of retorts are coated with heavy metals from the boiling of the “charge”





Some smelter sites end up on the
National Priorities List (aka Superfund)



Tulsa Fuel and Manufacturing



Environmental Cleanup of Historical Smelters is Expensive

For decades, the waste was used as fill and gravel.

Cleanups require a lot of public involvement and a lot of landowners are affected.

All smelter cleanups involve the cleanup of residential yards and other off site locations.

The sheer volume of waste is costly to manage. Often, on site disposal cells are constructed, which require long term management.

Questions?

Rita R. Kottke, Ph.D.
Remediation Programs Manager
Oklahoma Department of Environmental Quality
405-702-5156
rita.kottke@deq.ok.gov