Geoscience Education

Gold Rush Technology

1850s - 1990s

Educational Slide Set

Record No. 1996/9

Gary B. Lewis
Peter Hoban

A joint education project with

SOVEREIGN HILL
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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

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Developed &Written by: *Peter Hoban, Sovereign Hill Education Service*
Gary Lewis, AGSO Geoscience Education

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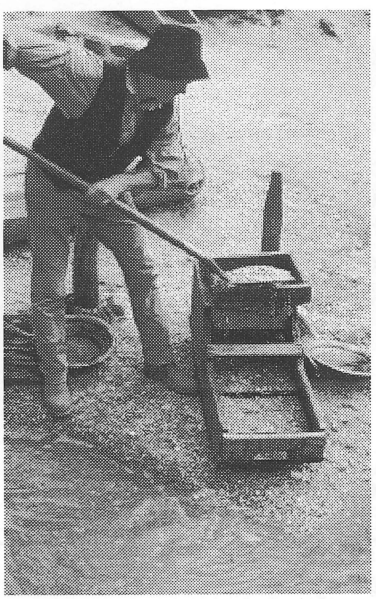
Gold Rush Technology 1850s - 1990s

The gold rushes, which started in a small stream in central NSW in 1851 and quickly spread throughout the country, dramatically changed the prosperity and cultural makeup of Australia. One interesting aspect of the gold rush period was the type of technology used and how it evolved to meet the changes in the location of "winnable" gold — from alluvial to underground hard-rock extraction.

More importantly, the gold rush never really ended. The search for gold deposits goes on in earnest and the wealth it provides the county is enormous. Likewise, the technology used to find economic deposits has also continued with the use of highly sophisticated instruments, computer modeling and geological knowledge.

This slide set highlights the technology of the gold rush period and the current technology used by government geoscience agencies to provide information used by companies or individuals interested in hunting for gold.

Slide 1. GOLD PAN AND CRADLE



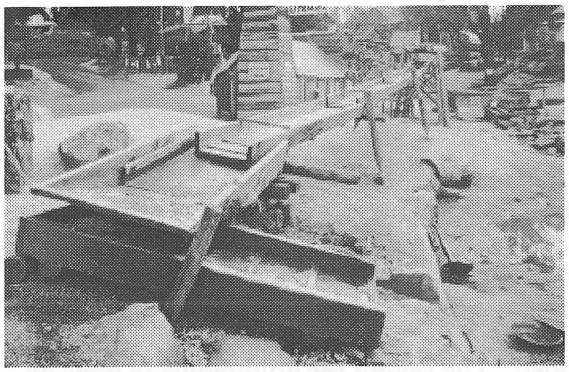
This slide shows the tools that diggers used to separate gold from dirt. Sometimes the diggers found gold as big nuggets that they could pick out. More often than not, the gold was in tiny pieces which had to be panned out of the dirt. Gold is heavier than other minerals so that when the digger shook the pan in water, the gold fell to the bottom. The gold pan has an edge on the bottom to catch the fine pieces. The skill is to remove the other rocks and gravel while leaving the gold behind. Many people still pan for gold today.

Sometimes a cradle was used. The cradle has a metal sieve on the top (to separate the larger stones) and small pieces of wood, called riffles, on the bottom. By rocking the cradle from side to side and adding water, the smaller pieces of dirt, rock and gold are washed through the sieve on top. Below, the heavier gold is trapped at the bottom of the riffles while the gravel and rocks are washed away. Sometimes corduroy material was used instead of riffles to trap fine gold.

Student Questions

Which device do you think would be better? Why? How would the diggers have got water into the cradle? Where would the dirty water go after panning and cradling? What problems might this have caused?

Slide 2. SLUICE & BROAD TOM



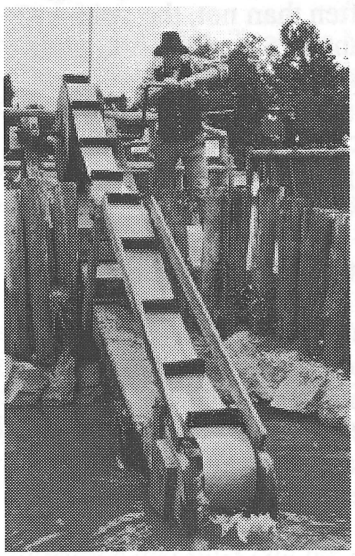
This slide shows a Broad Tom at the end of a sluice. The sluice is the long wooden channel which has a number of small pieces of timber, called riffles, on the bottom. The fine gold becomes trapped in these riffles in the same way that gold becomes trapped by slabs of rock in a creek. The Broad Tom is a section at the bottom of the sluice where miners could sort through the larger rocks and gravel, looking for nuggets and discarding everything else.

The miners needed a lot of water to make the sluice work so they built a flume to carry water from further up the stream. The water was trapped by a small dam and fed into the wooden race which allowed the water to flow down hill at a slighter gradient than the creek.
The flume is the wooden race that carries water across the creek and connects to the sluice. The flume becomes a sluice when it becomes steeper and riffles are used.

Student Questions

What materials did the miners use to build the flume? Why did they use these materials? What makes the water move along the flume? Why would the gold be caught in the riffles? What would miners do to ensure a steady flow of water in the flume?

Slide 3. THE CALIFORNIAN PUMP

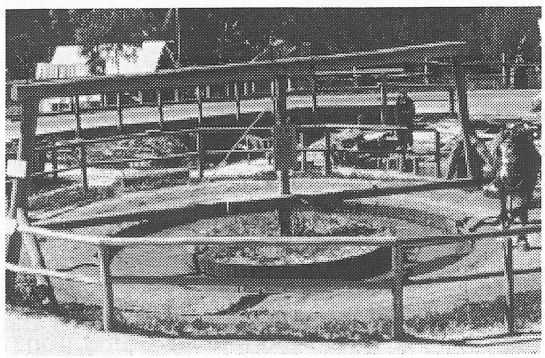


Miners needed water in the processes used to extract gold and sometimes they had to move water uphill. Using buckets could be very tiring. This slide shows a California Pump. Small boards are connected to a leather belt around two pulleys and the bottom end is placed in the water. The pump required a man to turn the handle to pull water up a wooden tunnel.

Student Questions

What materials were used to make it? Would this device successfully carry water a long distance? Could this machine be easily moved to another place? How many miners were needed to operate the pump effectively?

Slide 4. THE PUDDLING MACHINE



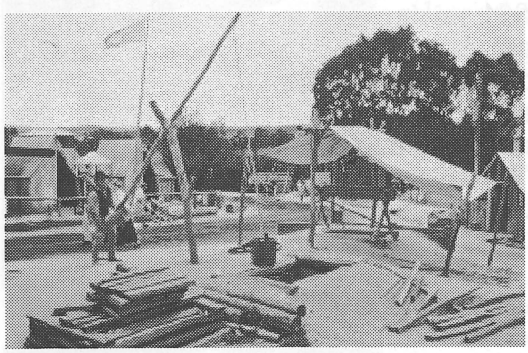
The California Pump at Sovereign Hill pumps water into the Puddling Machine. This device breaks up gold-bearing clay. The horse pulls 'rakes' in a circle through the trough filled with water. This breaks up lumps of clay in the water. Miners sometimes broke up the clay in a tub filled with water, but this machine was faster. The clay is carried away by water passing through the puddler, leaving the gravel and gold. This is then put through a Long Tom or cradle to separate the gold from the gravel.

If they could not afford their own puddler, miners sometimes paid other people to do this job.

Student Questions

Why does this process need water? How would the diggers get the gold-bearing mud out of the puddler after the clay was broken up ? Why would this Puddling Machine be expensive to operate? Why was a horse used?

Slide 5. WHIP AND WINDLASS

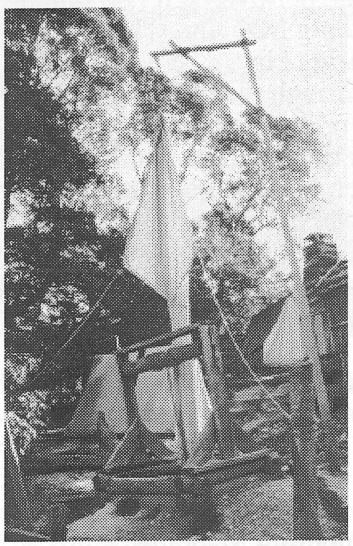


The goldrush started in 1851. Before long, all the surface gold had been found, so the miners had to dig deep shafts. They were looking for ancient, buried rivers and streams into which gold had been washed and trapped centuries ago. These mines were called deep lead mines because they followed ancient rivers or 'leads'. This slide shows a Whip and a Windlass. Both were used to lift dirt and water. The Whip is a simple lever and the Windlass is a pulley. The deep leads were very wet and often groups of miners had to work the windlass night and day to keep the hole from flooding.

Student Questions

Which device is the Whip and which is the Windlass? Why is there a weight on one end of the Whip? Which device would be best for deeper mines? Why?

Slide 6. WINDSAIL

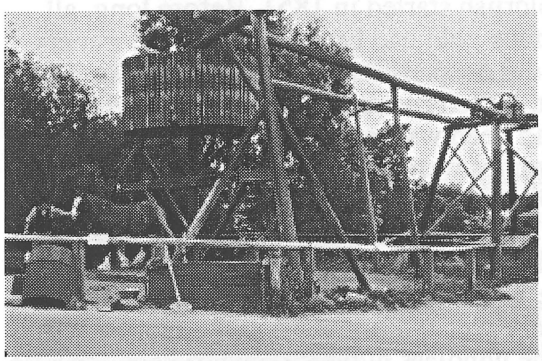


As the deep lead mines got deeper, the miners often encountered bad air. The Windsail was the method they used to get clean air into the mine. The idea came from sailing ships where scoops were set up to get clean air into the bottom of the ship.

Student Questions

Can you explain how the Windsail works? What material is used? What would happen when the wind changed direction? Would this device work on a still day? How many miners were needed to operate a Windsail?

Slide 7. THE WHIM



After 1854, mining rules were changed to allow for bigger claims to be worked by groups. As a result, diggers joined together to make mining easier and so they that could buy or make equipment using more advanced technology. On the Whim, one bucket lifts up the shaft while the other bucket is let down. A wire is wound from one bucket, over a pulley, around a drum, over another pulley and down to the other bucket. Because the miners used huge containers, the whim could bail 300 gallons (approximately 1,350 litres) of water per lift compared to the 10 or so gallons (45 litres) bailed using a Windlass.

Student Questions

How would this operation make mining faster? What power is used to make the Whim work? Why is the drum so large? Explain what happens when one bucket reaches the top. (Hint: Which way does the horse walk?)

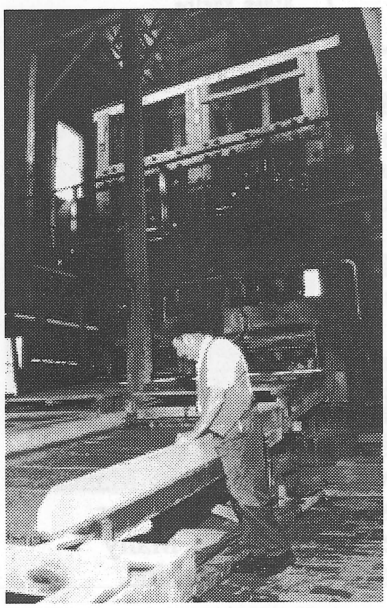
Slide 8. THE POPPET HEAD

Ballarat's mines grew ever deeper in the search for gold, and mining companies were formed to get enough money to buy and make expensive machinery. Some mines were up to a kilometre deep. These mines required a better system than a Windlass to raise and lower goods and people. The Poppet Head shown has pulleys on top for wires which carried cages operated by steam-driven winding gear inside a shed close by. Trucks carrying dirt would be raised to the first level and trundled out to be emptied on the mullock heap away from the mine entrance. Gold-bearing quartz rock was taken to the Battery House to be crushed.

Student Questions

Why was it necessary to create a pile of dirt (a mullock heap) away from the mine entrance? How do you think the engineers raised the corner legs of the Poppet Head? Why are there tow wires running from the Poppet Head to the winding gear?

Slide 9. THE BATTERY

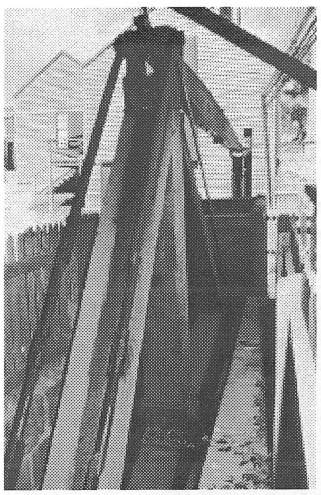


This machine operates at Sovereign Hill to crush quartz to release the gold inside. A steam engine turns the cams which lift the stampers. A labourer shovels quartz into the stamper box at the bottom where the heavy stampers fall to crush the rock. Water then carries the crushed rock, as sand, over mercury plates where most of the gold forms an amalgam with the mercury. The sludge left over then flows over a corduroy blanket where any remaining heavy gold is caught in the corduroy.

Student Questions

Why do they use corduroy blankets? Why do you think this machine is called the Battery? Why is water necessary?

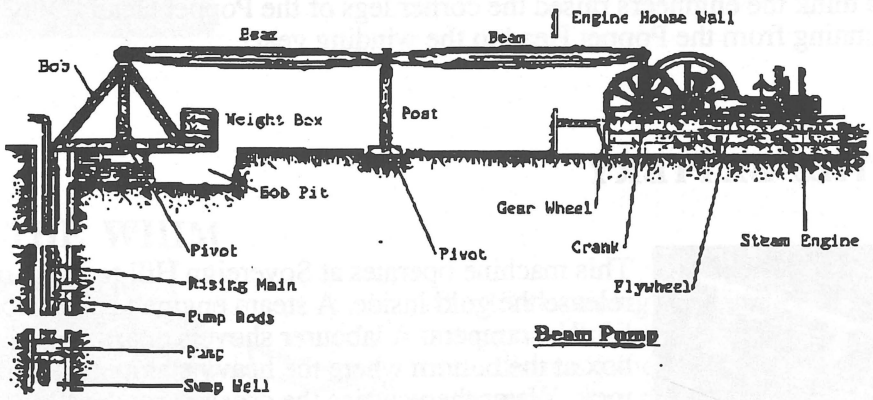
Slide 10. THE BEAM PUMP



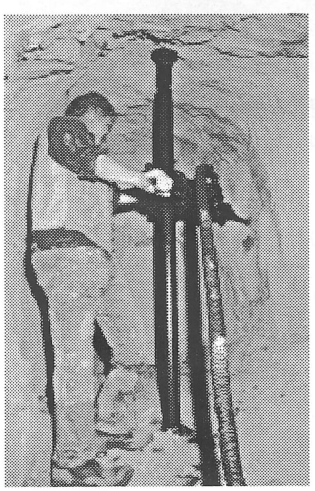
Water was a problem in quartz mines because they were below the water-table. The water had to be pumped out. This Beam Pump can push water out from up to 400 metres deep and is driven by a steam engine in the engine house. The beam connects the engine to a rocking A-framed structure called a hob which changes the motion from horizontal (sideways) to vertical (up and down). This pulls and pushes rods up and down a pipe. At the bottom of the rods is a pump. When the rod pulls up, water rushes into a sump. Each time the bob pushes the rods down, water is forced up an outlet pipe called a Rising Main. As it is very difficult to take a photograph of the whole pump, the diagram below will help you to understand how it operates.

Student Questions

How would they change this mechanism to cope when the mine got deeper? Why do you think the outlet pipe is called the rising main? Does this pump push or pull the water out of the mine?



Slide 11. THE SERGEANT ROCK DRILL



This drill was driven by compressed air made by a steam engine. The air was fed through pipes to the drill in the mine. The drill was used to bore holes in which explosives were laid to break away the rock face. This machine was also known as "The Widow Maker" because the dust it created caused a disease called Silicosis or "Miners' Lung" which eventually killed many miners. Many miners also went deaf because of the noise of this machine.

Student Questions

Would companies be allowed to use this sort of machine today? Why or why not?

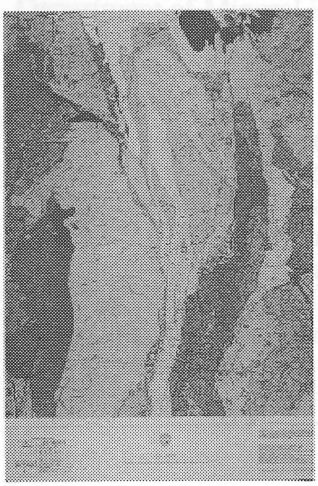
Slide 12. THE SURVEYOR

The surveyor was one of the most important men in a mine. It was his job to make sure the miners dug in the right direction. Miners had to stay within the limits of their claim and could get into serious trouble if they mined another company's claim. If they accidentally broke into a disused shaft, they could be flooded out by water. It was the surveyor's job to know where the other mines were (by reading maps) and to record his company's mines on a map as they were dug.

Student Questions
What do you think would have happened if a company mined in another company's claim?

Modern Technology used in the hunt for Gold

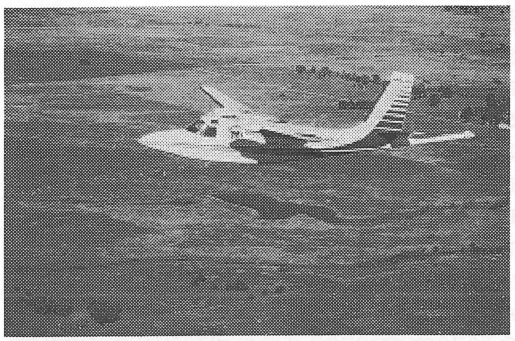
Slide 13 . GEOLOGICAL MAPS



The Australian Geological Survey Organisation (AGSO), formerly known as the Bureau of Mineral Resources, was established in 1946 to provide information about the geology of Australia and therefore stimulate the exploration for minerals. The most important role of AGSO and the state Geological Surveys, is the production of geological maps which summarise the rock types and their relationships to each other in any given area. Modern gold explorers use these maps to locate possible sites where they can undertake more detailed exploration.

Student Questions
Why have so many colours been used on the map? How do people using the map know exactly where they are on the map?

Slide 14. AIRBORNE SURVEYS



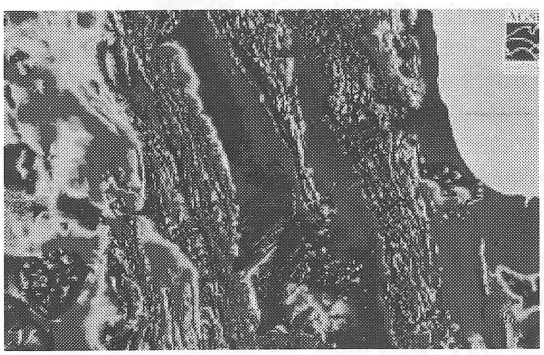
As well as the use of geological maps, modern mineral explorers don't only look at the rocks at the surface but use sophisticated instruments to survey the rocks which are slightly below the soil. One such survey method is to measure the magnetic properties of rocks. This can be done by flying a sensor over the ground and recording the readings. This plane is operated by AGSO to undertake these magnetic surveys.

The sensor is located in the "stinger" at the rear of the aircraft and readings are recorded by a computer inside. The pilot flies the plane at a given height (normally 60-100m above the ground) along a set flight path so that an entire area is covered during the course of the survey.

During an airborne survey, other information is also gathered such as radioactivity emited from the Earth's surface as well as the relief of the country flown over.

Student Questions
How difficult would it be to fly these surveys in very hilly country if the pilot must keep the plane at a set height? What other factors could hinder the survey? (wind, townships , powerlines etc)

Slide 15. MAGNETIC SURVEY MAP



Data collected by the airborne magnetic survey, known as "aeromag" by geoscientists, can be made into an image and printed out for the same area as a geological map. Using these images geologists and mineral explorers can locate further possible sites for more detailed study. In the image shown, the red colours show relatively strongly magnetic rocks and the blue colours weakly magnetic or non magnetised rocks.

Student Questions
As well as this "Aeromag map", what other maps would an explorer need to find possible deposits?

Australian Geological Survey Organisation

The Australian Geological Survey Organisation (AGSO) was established in 1946 (as the Bureau of Mineral Resources) to provide a national geological survey focus during the post-war boom period. Since this time, the Organisation has been instrumental in the discovery of numerous mineral and petroleum deposits and continues to provide the very best survey data and geological advice to government, industry and research institutions. The research which AGSO undertakes covers almost all areas of geoscience, including mineral exploration, onshore and offshore petroleum exploration, environmental and ground water geoscience, and geological hazards. Associated with this research is the storage and manipulation of geological and geophysical data and the production of cartographic and geographic information system (GIS) products.

Map Sales

Information on the current availability and prices of geological maps can be obtained from the following organisations :

Australian Geological Survey Organisation

Sales Centre
Constitution Avenue
Parkes, ACT 2600
ph (06) 249 9519
fax (06) 249 9982

or
Reply Paid Service 538
AGSO Sales Centre
GPO Box 378
Canberra ACT 2601
(no stamp required)

States

New South Wales
Customer Services
Department of Mineral Resources

ph (02) 901 8269
fax (02) 901 8247

Queensland
Information Services
Queensland Department of Minerals and Energy

ph (07) 237 1434
Fax (07) 221 9517

Tasmania
Data Management Group
Mineral Resources, Tasmania

ph (002) 33 8351
fax (002) 44 2117

Western Australia
Mining Information Centre
Department of Minerals and Energy

ph (09) 222 3459
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Northern Territory
Northern Territory Geological Survey

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ph (08) 274 7595
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Sovereign Hill is an exciting outdoor museum operated by the Sovereign Hill Museums Association (a non profit organisation). It tells the story of the first ten years of Ballarat's development after the discovery of gold in 1851. Activated businesses are run by costumed staff and buildings are 'peopled' by volunteers. All buildings and businesses are based on originals found in the Ballarat in the 1851 to 1861 decade, and are meticulously researched in every detail.

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Our education programmes are designed to cater for all year levels and most learning areas. The four Education Officers are qualified teachers from the Victorian Directorate and Catholic Education systems with many years experience at both Primary and Secondary levels.

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