TEACHERS EXHIBITION NOTES

THE STEAM REVOLUTION

This exhibition traces the development of steam technology — from the scientific experiments of the 1600s to the steam turbines that power electricity generators today.

There are many topics that can be investigated in **The steam revolution**; for example, technological change, technology and society, the Industrial Revolution, pressure, heat, electricity and energy resources.

The steam revolution is divided into the following sections.

Introduction

In this section videos and photographs show how traditional methods of work changed dramatically with the arrival of steam power some 250 years ago. The power of wind, water and animals was replaced by a virtually unlimited source of power that greatly increased productivity. The video of a working sawmill engine gives an impression of the relentless pace of mechanised work.

The area you are entering was the original engine room of the Ultimo power station. Here, the power for Sydney's first electric trams was generated. The engine room is the oldest part of the building. Completed in 1899, it remained in use until 1963, when the engines and turbines at last fell silent.

Steps towards steam

This section covers the scientific discoveries about air pressure and the nature of steam that led to the invention of the rotative steam engine by James Watt.

- 1643, Italy — Evangelista Torricelli invented the barometer and showed that air has weight and pressure.
- 1654, Germany — Otto von Guericke invented an air pump that could create a vacuum. He used atmospheric pressure to push a piston down inside a cylinder, thereby demonstrating that air pressure could be harnessed to do work. You can do this on our 'Feel the weight of air' interactive.
- 1690, France — Denis Papin used steam to push a piston up inside a cylinder. Atmospheric pressure pushed it back down.
- 1698, Britain — Thomas Savery developed a steam pump that was able to pump water from shallow mines. This was the first useful work obtained from steam.
- 1712, Britain — Thomas Newcomen built the first successful steam engine. It drove a pump to remove water from deep mines. Try the 'Put steam to work' interactive.
- 1782, Britain — James Watt transformed the simple pumping engine into an efficient power source able to (literally) 'turn the wheels of industry'. See a 1:12 scale model of the Boulton and Watt engine here, or visit the real thing in the Wran Building on level 4.

Steam goes bush

This section is set around a Maudslay steam engine. Brought to Australia in 1837, it drove a brewing and flour mill complex at Goulburn. This was one of the first engines used in country NSW. In the 1830s millers found it cheaper to bring an engine to a country town than to send wheat to Sydney for processing. There was no railway, just rutted roads.

The Maudslay was a tried and trusted design although it was quite old-fashioned in its time. But it was a sound choice for the 'bush',

where repairs would probably be done by the local blacksmith. You can still find many examples of technological conservatism in use today.

The story of Henry Maudslay and his team of engineers is told here. They brought new levels of accuracy and standardisation to manufacturing.

A boiler is beside the Maudslay engine to remind visitors that steam has to be produced to power these engines. The real boiler is in the basement of the Powerhouse.

Turning on the tap

You can follow the development of Sydney's water supply and look at remnants of the Botany Pumping Station in this section. The cylinder and valve gear on display are all that remain of three huge engines that, from 1859 to 1886, pumped water from the Botany Swamps to many Sydney homes. Prior to this, most people had to collect water from wells and pumps and carry it home in buckets. That was hard work! You can get an idea of the effort involved by trying the 'Pumping some water' interactive.

Designed for power

A collection of compact high-pressure steam engines like those developed in the 1800s are on display. They could fit into confined spaces in factories or boats. Various arrangements of engine parts were tried. A video compares these types.

Steam on the move

In 1801, Richard Trevithick pioneered the use of high-pressure steam in engines. There was resistance on safety grounds, but this was outweighed by the need for cheap, light and small steam engines. This breakthrough made steam engines suitable for road vehicles (traction engines) and locomotives. Trevithick built the world's first steam locomotive in 1808.

'Steam on the move' displays portable engines that could be moved from place to place to do their work. The high-pressure engines were compact and light enough for horses to pull the vehicle.

The Merryweather horse-drawn steam fire pump was built in 1896. It was used at Broken Hill until 1922 to fight over 1000 fires. The horses, Prince and Kate, knew the fire bell so well that they lined-up under the harness by themselves when the alarm sounded.

Next to the fire pump is a Ransome, Sims & Jefferies portable engine, probably brought to Australia in the early 1900s. Engines like this were dragged from farm to farm by teams of bullocks or horses. Rather than buy an engine themselves, farmers hired contractors with engines. They used the engines to power ploughs, sheep-shearing equipment, threshing machines, chaffcutters, water pumps, sawmills and 'sheep washers'.

Farm workers saw mechanisation as a mixed blessing. It made some jobs easier, but people struggled to keep up with the relentless pace of machines. In Britain the legendary Captain Swing led riots against the machines. Rioters swept through the countryside smashing machines that threatened their jobs. In Australia, the problems were less severe. By 1860, when steam-powered machines became widely used, many farm labourers had left for the goldfields. Those who stayed could command good pay and conditions.

All work ... no play

This section looks at the large steam engines that drove factory machinery all around the world before World War II. A 1909 Marshall compound engine is connected to a printing press by line shafting. Line shafting is a complex system of belts and pulleys that transmits power from one engine to many machines. This engine originally drove a gold dredge and then a sawmill in Victoria.

Factories were not pleasant places — they were dirty, noisy places where the work was monotonous and relentless. However, conditions in Australia were not as bad as those in the 19th-century mills of northern England.

Roll up! Roll up!

Here you'll find out about fairgrounds and their steam-powered entertainments. Travelling fairs brought a splash of gaiety and colour to people whose lives were spent in industrial surroundings.

The power of steam engines allowed large and elaborate rides to be built. Savages Ltd was the most successful merry-go-round builder. The horses on display are modelled on original Savage horses. A Tangye engine powers these horses. Sorry, no rides are allowed.

A Savage engine powers the barrel organ. This one may be a pre-1900 Wurlitzer. An ice-cream machine is also on show — but not operating!

Designed for speed

On display here is an engine that operates at the high speed needed to run an electricity generator. You can also see excerpts from *Metropolis*, the 1920s movie predicting future uses of machinery and labour.

The Belliss and Morcom engine drove electric generators at the Chicago Mills in Lane Cove from 1929 to 1960. From 1900, over 600 of this type were brought to Australia. The key to their success was a pressure lubrication system, which pumped oil directly to the engine's working parts. The system is used in almost all engines today, including car engines.

The city electric

This section looks at the spread of electricity and the turbines that generated it.

Following the invention of the incandescent light bulb and the steam turbine, electric lights began to appear in houses, factories and city streets in the 1880s. Crowds would gather for public demonstrations of lighting. One such demonstration was in Hyde Park, Sydney, in 1903.

Steam turbines were cheaper to build and run than piston and cylinder engines and easily reached the speeds needed to drive electricity generators. The cheap electricity provided by steam turbines transformed the way people worked and lived. Effective lighting cut crime in the streets and allowed work to continue through the night. Electric trams and trains meant people could live in new suburbs, far from their work. They also provided an escape route to the beaches and the countryside at weekends.

Charles Parsons produced the first practical and efficient steam turbine in the 1880s. The Parsons turbine on display may have been one of a pair used for the demonstration in Hyde Park in 1903.

Parsons turbines were revolutionary because they had many small blades to spin a shaft. Earlier ones had a single blade, causing them to turn too fast and sometimes self-destruct.

Steam turbines are still used to generate 90% of Australia's electricity and also to power some large ships.

Also included in this section are interactives and displays showing the use of turbines, some obsolete and some fanciful applications of steam power (from locomotives to steam airships), electrical appliances, and an interactive video game where you can answer questions on energy resources.

The *Earl Spencer's* cargo

This display rounds off the exhibition by looking at the arrival of the first steam engine in NSW. The main object is a large, old boiler.

In 1813 the *Earl Spencer* arrived in Sydney Harbour carrying the first steam engine to be brought to the colony of NSW. Until this time, mechanical work had been done by windmills, convict treadmills or animals. The engine was installed in John Dickson's flour mill at Darling Harbour. Today, Dixon Street is a misspelt reminder of the site of Australia's first steam engine.

In 1827, Thomas Barker built another steam-powered mill beside Dickson's. Both pioneers of steam became well known and wealthy.

The Day Street boiler was unearthed in 1976 during excavations in Day Street for the

Western Distributor freeway. Its history is uncertain, but its construction is of the type that would have been used on Dickson's steam engine. The site where it was found was once John Struth's engineering works. The boiler may have been brought there to be broken up and melted down.

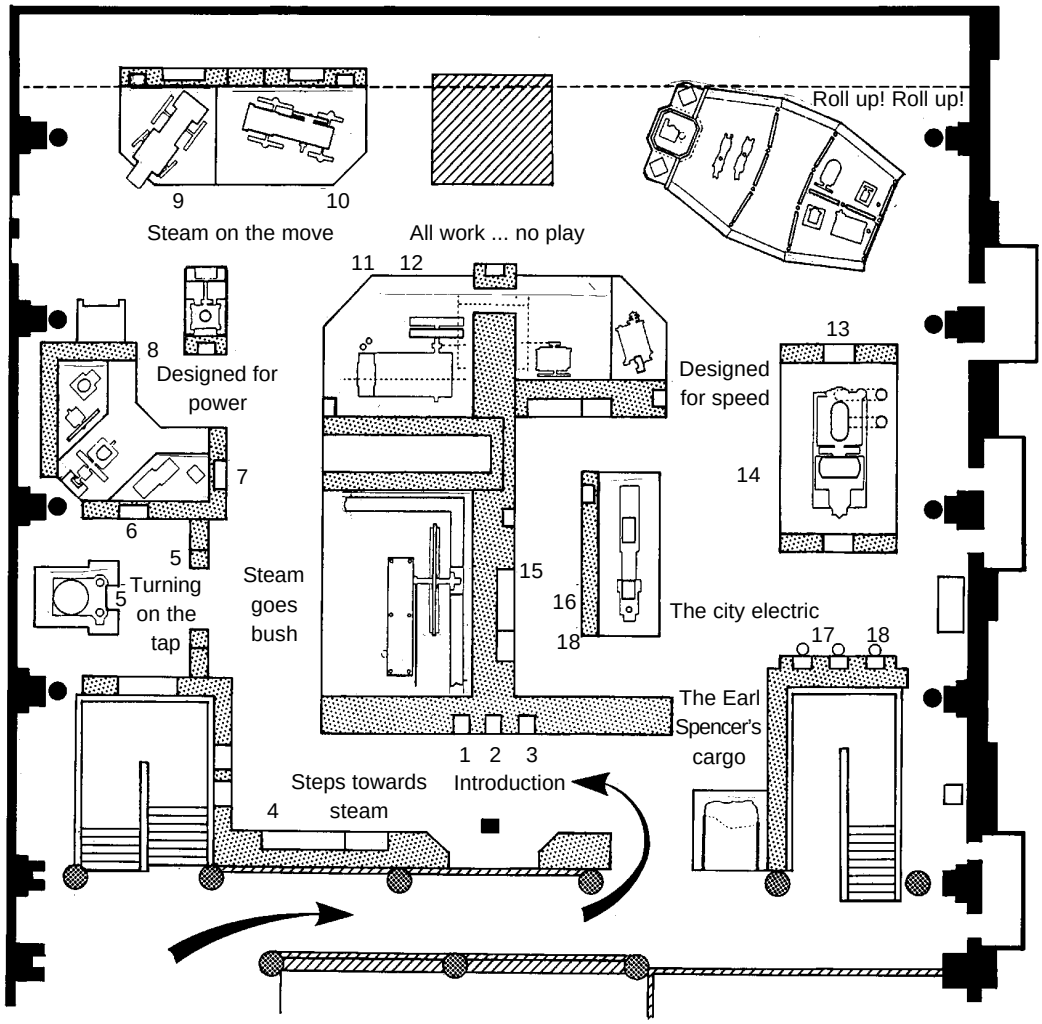
FOCUS QUESTIONS

Select questions that will help your students interpret the exhibition. If necessary, adapt the questions to suit the ability of your group. The answers can be found by looking at the objects, photographs, videos and labels, and by using the interactive (hands-on) exhibits.

Turn left when entering the exhibition and start at the old photographs of people at work.

1. How many different power sources can you see?
   (wind, hand, animal, water)
2. What jobs were done by manual labour?
   (milling, carting, pumping, harvesting, shearing, making cloth, cutting timber, mining, milking)
3. What sorts of jobs did steam engines do?
   (ploughing, lifting, printing, manufacturing textiles, pumping water, shearing, generating electricity)
4. Who built the first successful steam engine? When? What work did it do?
   (Newcomen; 1712; pumped water from mines)
5. Where did the huge piece of pumping machinery come from? What did it do?
   (Botany Pumping Station; pumped water to Sydney, 1859–86)
6. Try out the hand-operated water pump. How was water collected for a house in Sydney 150 years ago? Who did the work?
   (wells and pumps; mainly women and children)
7. Why was Henry Maudslay famous? Can you find an engine made by his company?
   (high standards of engineering; Maudslay beam engine)
8. Can you find the engine that worked in a cheese factory in Bega? Why were small engines a good idea in factories?
   (the Tangye inverted engine; it took up little floor space)
9. Watch the historic film about firefighting behind the red fire pump. How was the fire pump moved to the fire?
   (horse drawn; Prince and Kate pulled this pump)
10. Find the Ransome, Sims & Jefferies portable engine. This engine worked on farms but it did not move like a tractor. How was it moved from place to place?
    (dragged from farm to farm by bullock teams or horses)
11. How can one steam engine power several machines at once? Which engine in the exhibition is set up to do this? What machine does it power?
    (belt and pulley system; Marshall; printing press)
12. Which engine once floated down a river? What did it do?
    (Marshall; dredged for gold)
13. Find the engine on display that helped to make Uncle Toby's Oats. What part did it play?
    (the Belliss and Morcom engine; generated electricity as backup)
14. Which two engines on display were used to make electricity? Where did each one work?
    (Belliss and Morcom, Lane Cove; Parsons, Hyde Park)
15. Find the turbines you can use. What are the two types called and how old are the ideas?
    (Hero of Alexandria's reaction turbine, 2000 years old; Branca's impulse turbine, the 1500s, the idea may be older)
16. Is steam still used today? Where?
    (yes; mainly electricity generation)
17. Play the *Energy game*. Is there one form of energy for the future that is 'best'?
    (no, all forms have some disadvantages)
18. Why will steam technology be used to generate electricity for a long time to come?
    (many alternative sources of heat can be used to produce steam and steam turbines can convert this heat to motion and then to electricity)

EXHIBITION FLOORPLAN
The steam revolution, level 3



Numbers refer to focus questions

For details of other exhibitions and ways that students can visit the Powerhouse Museum, consult the current *Powerhouse teachers guide* or **call** (02) 9217 0222 or **fax** (02) 9217 0441 or **email** edserv@phm.gov.au

Available from the Powerhouse Shop
Locomotive N° 1, a full-colour booklet on the first locomotive in NSW.
ISBN 1 86317 024 3, 8 pp, $3.
The Boulton and Watt engine. ISBN 1 86317 032 4, 8 pp, $3.

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