**James Watt 200th Anniversary 1736-1819 St Mary’s Handsworth 25 August 2019**

In the Encyclopaedia Britannica Lord Jeffrey is cited saying Mr. JAMES WATT, the great improver of the steam-engine, died on the 25th of August 1819, at his seat of Heathfield, near Birmingham, in the 84th year of his age. He was buried on 2 September in the graveyard of St Mary’s Church, Handsforth

We believe in a giving God, who gave us this world to explore, harness and steward; who gave us his son, Jesus to live among us, die for us and rise again to be our Saviour and our Lord; who gave the Holy Spirit, to unite us in the truth, to encourage us to love and send us out in mission.
We also believe in a God who gave us the gift of one another, men and women, made in the image of God, for whom Christ died.
and with that gift he gave us the responsibility to discover the gifts we have been given and to develop them for the welfare of society, the building up of the church, the extension of the kingdom and the glory of God.

James Watt, who died two hundred years ago today and who is buried in this church was one such gift to humankind. He was someone who used his life to the full and in so doing blessed many others.

As an inventor and engineer, he created and improved countless devices which changed many people’s daily lives, including making, as a church organist told me recently, organs for churches!

However, he is rightly remembered for his achievements in harnessing the power of steam, which is in turn drove the industrial revolution, changing for world he believed for the better, for all time. The Industrial Revolution is sometimes called “the Age of Steam” in no small measure because of James Watt.

Watt did not invent the steam engine. Steam engines were already in existence, mainly being used to pump water out of mines. What he did do was to make important changes to the design, thereby increasing efficiency and making steam engines cheaper to run.

He made the steam engine stronger, safer, more efficient, economic and reliable. What he gave, is what all the world desires to have – power.

James Watt was the powerhouse behind the Industrial Revolution. Steam power brought new and startling innovations. Coal mines used steam engines to pump water from deep underground. Textile mills harnessed the power of steam to drive looms. Steam trains and steam ships revolutionised transport around the world. James Watt's name became so closely tied to 'power' that a unit of power, the 'watt' (one joule of energy per second) was named in his honour.

However James Watt was also a child of that remarkable period in Scottish history called “The Scottish Enlightenment.” The Scottish Enlightenment was part of a wider European movement, reaching its height in Scotland between 1750-1800. The great French philosopher and historian Voltaire (1694-1778) said “We look to Scotland for all our ideas of civilisation.” Much later Sir Winston Churchill wrote ' Of all the small nations of this earth,

perhaps only the ancient Greeks surpass the Scots in their contribution to mankind.’ Today many historians believe that the Scottish Enlightenment helped to shape the modern world.

The seeds of the Scottish enlightenment are found in the Reformation’s emphasis on education, and learning with its vision a school in every parish and the general respect for education throughout the country. At the time of the Enlightenment there were two Universities in England, Oxford and Cambridge, and five in Scotland namely Edinburgh, Glasgow, St Andrew’s and two in Aberdeen, Kings College and Marshall College. The Scots used to boast that Aberdeen City had as many universities as the whole of England combined!

These Universities were probably, up to the end of the 17th century, competent institutions,

but by no means world class but in the 18th century they were revolutionised and changed fundamentally. They started to lecture in English rather than Latin. They started to establish specialist teaching. as Professors were appointed for particular fields and encouraged esearch in that area

Eighteenth century Scotland has been described as ‘a hotbed of genius’. Scholars, born and educated in Scotland, sought to understand the natural world and the human mind. They were encouraged to look at things in a new way and there was an underlying belief in the inevitability of progress. They wanted to improve the world through new ideas, fresh thinking, new discoveries and inventions.

Many of the leading lights of the Enlightenment were close friends. They regularly met to eat, drink and debate. They started clubs and societies where they could socialise, discuss and exchange ideas. That was the internet of their day When scholars from different fields met

they freely shared their ideas they learned from one another. It was a wonderfully civilised and sociable atmosphere. You could have an argument between two of the major figures but afterwards they would still remain friends. That is one of the things we need to re-learn!

We live in a society today where it is almost fashionable to be “outraged” at everything. No wonder we cannot hear what others are saying.

Edinburgh would be known in this period as “The Athens of the North” centred round a group of extraordinary people creating possibly the most dynamic city on Earth. Many of the greatest scientists, artists, philosophers, designers, writers, economists and more were all working side by side, bouncing their ideas off each other, learning from their friends, and debating their discoveries. They were interested in everything and were truly interdisciplinary in their approaches, true polymaths. They had much in common, but above all, they shared two principles: Observation & Analysis. Their discoveries and new thinking built the foundations of a modern way of life.

If the focus looking back is often on Edinburgh then Glasgow was arguably the birthplace

of the Scottish Enlightenment.

It was Francis Hutcheson, Professor of Moral Philosophy at Glasgow University, who paved the way for a more moderate Church and inspired Enlightenment thinking. After the bitter conflicts within the church of a pervious century he was determined to change the face of theology in Scotland, noting, 'I hope I am contributing to promote the more moderate and charitable sentiments in religious matters in this country.’

Among Hutcheson’s students was Alexander ‘Jupiter’ Carlyle who became a leading moderate within the Presbyterian Kirk and rose to become Moderator of the General Assembly and Dean of the Chapel Royal.

The harsh Calvinist ministers lost their grip on power as the moderate party within the Kirk gradually changed the Church of Scotland. Many of Edinburgh's Enlightenment leading lights were first recognised and given professorships in Glasgow. James Black and Adam Smith both lectured in Glasgow. James Watt was a close friend of Joseph Black and was employed by Glasgow University as appointed as a mathematical instrument maker.

The Earl of Buchan noted that in 1762: 'I attended the Lectured of your worthy Leechman, of Adam Smith, Joseph Black, John Anderson, and John Millar, a Groupe not equalled in their Departments at that time at any University in the world.'

Glasgow was a major trading port in the 18th century sadly based on the infamous slave trade

The city boomed as ships criss-crossed the Atlantic between the Clyde and America. Tobacco barons invested their profits in lavish country houses. Wide modern Georgian streets and squares reshaped the city. Adam Smith’s connections with Glasgow's merchants directly influenced 'The Wealth of Nations'.

Other factors assisted the development of the Scottish Enlightenment including

the close links Scotland had with Europe and European culture

the Union of the Parliaments in 1707 which took political debate south of the border and left people free to focus on other things

the end of the Jacobite struggle in 1745 with the disastrous defeat at Culloden, which took all the passion out and left people in a more peaceful and settled situation to explore ideas and develop their thoughts

Among those of this period were David Hume the philosopher, Adam Smith the Economist,

Robert Adam and James Craig the architects who built the New Town of Edinburgh, James Hutton the geologist, Joseph Black the chemist, John Hope the botanist, Robert Burns the poet and so many more.

Among them was James Watt whom we remember and honour today

James Watt of highland stock was born in Greenock in 1736. His parents were both Covenanters, strict Presbyterians. Though Watt did not share all their religious convictions

he remained a church attender all his days. He may not have subscribed to some of their theological tenets but he would have imbibed the culture of Reformed theology which aimed to integrate faith and life, to live in the world “before the face of God ” with a belief that every legitimate profession is a calling from God.

James Watt was not a healthy child and was educated at home for most of his early years.

His father was a carpenter and shipwright who set himself up in business as a merchant and ship-owner. Watt liked to make models and repair nautical instruments in his father's workshop.

In 1755 Watt went to London to be an apprentice scientific instrument maker. He was a quick learner and mastered his craft in one year, including the making of musical instruments. Aged 19 he returned to Glasgow, where he set up his own business.

Before long he was recognised as a high-quality mechanical engineer, and employed on the Forth and Clyde Canal and the Caledonian Canal. He was also involved in the improvement of harbours and in the deepening of Scottish rivers, including the Forth and the Clyde..

James Watt then met Joseph Black, who then was Professor of Chemistry at Glasgow University. The men became friends. Watt provided model engines for Black

to use in his lectures on the properties of heat.

There is a popular story that Watt was inspired to invent the steam engine by seeing a kettle boiling, the steam forcing the lid to rise and thus showing Watt the power of steam.

This story is told in many forms; in some Watt is a young lad, in others he is older, sometimes it's his mother's kettle, sometimes his aunt's. The story of Watt and the kettle may have been created his son James Watt Jr., and persists because it is easy for children to understand and remember. In this light it can be seen as akin to the story of Isaac Newton, the falling apple and his discovery of gravity.

Although it is often dismissed as a myth, like most good stories the story of James Watt and the kettle has a basis in fact. In trying to understand the thermodynamics of heat and steam

James Watt carried out many laboratory experiments and his diaries record that in conducting these he used a kettle as a boiler to generate steam.

One Sunday in 1765, Watt was struck by the idea that was to spark the Industrial Revolution.

Walking in a park near the Clyde, he suddenly realised how he could make the standard Newcomen steam engine more efficient.

The problem was that the Newcomen steam engine required enormous amounts of steam to work, and always broke down after a short time, making it inefficient and unreliable. Vast quantities of steam were needed because the cylinder had to be cooled after every single stroke of the pump, and then reheated. In so doing it lost 75% of its energy. The regular breakdown was caused by the boiler being too small to actually reheat the cylinder so frequently.

What was needed was a vacuum in which to condense the steam *without* having to cool the cylinder after every stroke. He solved this problem by adding a condenser separate from the piston to cool the steam, and putting a “steam jacket” around the piston to keep its temperature the same as the steam going into it. His separate steam condenser created this vacuum, making the engine more efficient, reliable, economic and powerful.

However it would be eleven years before he saw it at work in a steam engine. Watt was delayed by legal and financial setbacks outwith his control. He had to search for a financial backer for what was a very expensive project – and a Mr John Roebuck an Englishman living in Falkirk put his faith in Watt.

Watt then had to build a large engine which worked well enough for him to apply for a patent. This too, took time as a patent can only be granted by Act of Parliament. He patented his steam engine condensing chamber in 1769. He also needed the facilities to develop the engine, and Matthew Boulton from Birmingham, seeing its potential, offered his facilities, confident he could sell Watt’s engine on a large scale.

He and Mr Roebuck though, were unable to agree business terms, and the project was delayed for eight years until the bankruptcy of Mr Roebuck, when Mr Boulton acquired

his rights to the engine, and work was eventually able to restart.

In 1774, Watt started a business in Birmingham with investor Matthew Boulton to manufacture his improved steam engine. Without Boulton’ s faith and patience,

the Boulton-Watt steam engine would never have seen the light of day, outperforming

the old Newcomen engine five times over.

Watt was the artist, credited for its creation, Boulton was the businessman, who takes credit for the production. Boulton was that rare creature – an industrialist with a vision beyond simply profit. Unlike other industries whereby individual craftsmen work separately, Boulton gathered the best equipment and finest craftsmen under one roof, which he calls a "manufactory".

Watt’s engine therefore had immediate access to some of the best iron workers in the world, and Mr Boulton's manufactory provided the expertise and precision that had been lacking in his partnership with Mr Roebuck. The Boulton & Watt Company produced steam engines that could be used anywhere, and demand for them was high. Watt and Boulton became leading figures in the Industrial Revolution.

Sir Walter Scott himself suggested that “Watt the mechanic is almost as important as Watt the inventor.” Watt continued to make improvements to steam engines adding to their force and flexibility. He developed the compound engine to increase its power. He added a throttle valve to control this power; a centrifugal governor to stop it from "running away"; and a pressure gauge for the cylinder, in addition to improvements which make for easier manufacture and installation.

He patented other important inventions, such as the rotary engine **which mechanised weaving, spinning and transport, the** steam locomotive and the rev counter

Steam revolutionised industry, and his engines were used in ships, locomotives, mines,

cotton mills, wool mills, flour mills… in fact, everywhere power was required.

His engines his contemporaries claimed “have increased indefinitely the mass of human comforts and enjoyments, and rendered cheap and accessible all over the world the materials of wealth and prosperity”.

To show the difference they made let me give one example. A Boulton-Watt engine was supplied to a sawmill to undertake the work previously carried out by twelve horses. Watt calculated that one horse had the strength to pull 33,000 pounds, the distance of one foot, in one minute – This strength, he referred to as “horse power”- a term he gave to the world.

His engine was capable of the power of 26,000 horses! far exceeding the capacity of the 12 at the mill!

Sir Walter Scott wrote: “Mr Watt discovered the means of multiplying our national resources to a degree perhaps even beyond his own stupendous powers of calculation!

His achievements were recognised by fellow scientists. He was a fellow of the Royal Society of Edinburgh and the Royal Society of London, and became a Foreign Associate of the French Academy of Sciences.

Watt combined theoretical knowledge of science with the ability to apply it practically.

One contemporary wrote "Those who consider James Watt only as a great practical mechanic form a very erroneous idea of his character. He was equally distinguished

as a natural philosopher and a chemist, and his inventions demonstrate his profound knowledge of those sciences, and that peculiar characteristic of genius, the union of them for practical application”

He was greatly respected by other prominent men of the period. He was an important member

of the Lunar Society of Birmingham, a dinner club and informal learned society

of prominent figures in the Midlands Enlightenment , including industrialists, natural philosophers and intellectuals, who met regularly between 1765 and 1813. Watt was a much sought-after conversationalist and companion, always interested in expanding his horizons.

His personal relationships with his friends and partners were always congenial and long-lasting for Watt was a prolific correspondent.

Today in a world where issues concerning climate change dominate the headlines and questions about the using up of the earth’s finite resources and the notion of unending growth

are questioned some might raise questions as to the value of the work of people like James Watt. But 200 years ago there was no doubt about the difference he had made to people’s lives.

Watt was part of a long line of Christians who produced technological advancements aimed at both increasing productivity and eliminating drudgery on a biblical understanding about work. He and his contemporaries were committed to the unique dignity of each person,

and to the value of work and production. They aimed to make work meaningful, by developing technologies aimed at improving production and benefiting ordinary workers.

The development of the steam engine set the stage for the entire industrial revolution and the unprecedented prosperity that followed.

Outside his work James Watt was married, though his first wife, Margaret, died in childbirth in 1773, leaving him with two young children. He then married Ann in 1776 and had a son and a daughter, who died of consumption before their father's death.

As we reflect on this extraordinary life we give thanks today for someone who used the gifts he was given to the full, not least the gifts of imagination and curiosity, which, when coupled

with hard work and determination and allied to the skills and gifts of others impacted his society and every subsequent generation to the present day.

A colossal statue of Watt by Chantray was placed in Westminster Abbey and later was moved to Stm Paul’s Cathedral. The inscription reads, in part, "JAMES WATT ... ENLARGED THE RESOURCES OF HIS COUNTRY, INCREASED THE POWER OF MAN, AND ROSE TO AN EMINENT PLACE AMONG THE MOST ILLUSTRIOUS FOLLOWERS OF SCIENCE AND THE REAL BENEFACTORS OF THE WORLD."

200 years on from his death, we give thanks to God for a life well lived.

**Re Rev Colin A M Sinclair**

**Moderator of the General Assembly of the Church of Scotland**