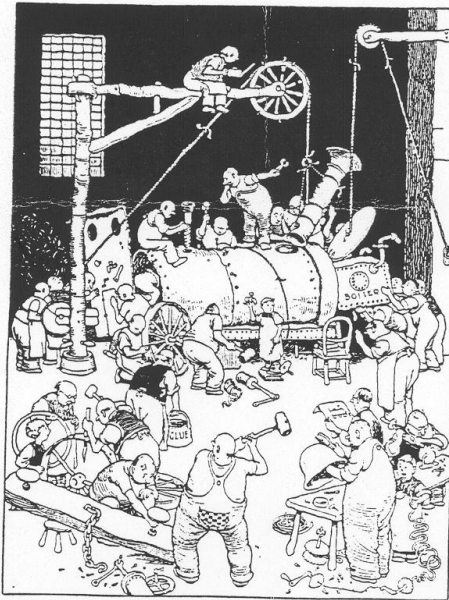


# Crabtree and the

ART

OF

TECHNOLOGY



CRABTREE'S DOPE BEING USED IN  
LOCOMOTIVE CONSTRUCTION

N.W. MURRAY

The XV Crabtree Oration 1990

Australian Chapter

The Crabtree Foundation (Australian Chapter)  
The XV Crabtree Oration  
*Crabtree and the Art of Technology*

N. W. Murray  
February 1990

Gentlemen, ...

It is my experience that in my life it is usual for the Burden to be carried first and it is only afterwards that one is lucky there may be an Honour. With the Crabtree Foundation this order has been reversed. The Living Witness phoned me to announce the Honour of being this Chapter's 1990 Orator. With a carefully chosen mixture of enthusiasm, pride and humility I accepted the Honour and it was several weeks before I realized the true and special meaning of the word Burden, particularly when it relates to the Crabtree Foundation. I now place my Burden before you.

But my apprehensions are not those of ordinary mortals. You see I was educated in a country school with seven or eight other children and then went to another country higher primary school for my secondary education. At the time my only expertise was in the extraction of lactic fluids from the mamillary glands of the female genus bovine. That was all I knew. I did not know whether this school was good, bad or indifferent but being an obedient scholar I did everything I was told. Our history teacher was the headmaster the fattest man I had ever seen to that stage of my short career and who lived in the house attached to the school.

At the beginning of the school year he told us to read the set history book, which I did, but he hardly ever appeared in class. When he did appear in the middle of the morning he would be dressed in his usual grey suit but underneath in place of a shirt was his pyjama top with a tie and showing under the suit trouser bottoms was about two inches of pyjama trouser bottoms. Left to our own devices I decided that if I were to pass the government examination in history at the end of the year I should learn all of the names and years of the kings and queens of England. Unfortunately for me the examiners of that year had no interest in that royal procession and history was the one subject I failed but I admit that Latin must have been a pretty close thing because two days after that exam the only Latin I could recall was the school motto which I have also now forgotten. So you see how ill-equipped I am to be a Crabtree Orator; the one consolation being that orations can only improve from 1990 onwards.

Returning to what you will now see is a truly-ruly Burden, I shall try to tell you how my researches into the life of Joseph Crabtree have disclosed amazing revelations about his activities in many parts of the world in the fields of structural engineering, theoretical stress analysis and natural philosophy. I say amazing because I have read literally hundreds of books in these fields and there was no mention of his name. However, having read some of the previous Crabtree Orations I began to realize that his was a curious mixture of secrecy, modesty and intrigue. I know who had a long-running affair with Mozart's wife Constanze and finally murdered Mozart in revenge for contracting certain diseases, why Professor Black of Glasgow died in such strange circumstances and so on.

Tonight I want to enlighten you about Joseph Crabtree's activities as a practitioner in the

Art of Technology. But before doing so I would like to air two very small grievances with previous orators. Although the Revered, the Late-Living Memory lived for 100 years (1754 to 1854) the first grievance relates to historical accuracy to which the 1989 Orator Dr Phillip Law so ably referred. My grievance is that previous orators, all distinguished scholars, have almost completely filled those 100 years with the revelations of the activities and comings and goings of the Late-Living Memory that there appears to be only a few fleeting moments of his life left into which I can squeeze his amazing exploits of conception, design, construction and erection. But as we all know only too well all of these things take considerable time and effort. How can I use up great chunks of that 100 years without on the one hand calling at least some of the former orators damned liars and on the other hand how can I look subsequent orators squarely in the eye knowing that the only moments of Crabtree's life not yet accounted for will be very few in number and duration? And most of these moments seem to have been circumscribed by somewhat circumspect circumstances, if I might indulge in a little alliteration.

But now to my main task, to reveal the life of Joseph Crabtree, the builder. I shall first set the historical scene. 1754 to 1854 embraced the Industrial Revolution in Great Britain.

It hasn't quite reached us yet here in Australia but when it does you will all realize that it was a time of immense activity taking Britain from one Dark Age into yet another Dark Age. Not only was gin on everybody's lips but there also hung the names of great engineers such as George Stephenson (1781-1849), son Robert (1803-1859), Richard Trevithick (1771-1833), Isambard Kingdom Brunel (1806-1859) and so on. The list is a very long one. I know from the revelations of previous orators that the Late-Living Memory was a practical man, that he was observant and had many excellent qualities which we, his disciples, all revere. However, his achilles heel was that he was ambitious to be always at the centre of the action. When the arts were fashionable he wrote his greatest literary works, "Ode on Claret" and from our learned and distant cousin, the London Crabtree Orator of 1989, with the propitious name of Dr J.C. Foreman, we learn of Crabtree's love not only of music but also even of Mozart's wife Constanze from whom we have already noted he seems to have received at the tender age of 37 a mild and transitory attack of venereal disease. But I digress. The 1986 Australian Orator, Professor Roy Jackson, told us that with the rise of chemistry Joseph Crabtree was in there not only changing the colours of the elements but also clearing the field for himself by, shall we say, "arranging" for the demise of Priestly, Cavendish, Black and others. I apologize to Professor Jackson if I have misinterpreted his theme but it was a little difficult to follow his logic at the time, partly as a result of my own experiments with a certain reddish fluid which I was sharing with the living spirit of Joseph Crabtree. What then was the next logical development in his life? It was, of course, the application of all of this knowledge of the arts and sciences to the practical world of engineering. So this brings me now to the main part of my address.

You may well ask how a country gentleman of Chipping Sodbury would be able to make his way in the profession of engineering. Obviously he, like all other educated gentlemen of the time, had read Newton's "Principia" and he had repeated Newton's famous experiment many times by sitting under crab-apple trees. Eventually he had been clopped on the head by something and we can only presume about what it was.

Thus he became convinced about the existence of the Force of Gravity, even holding public lectures on this subject in Chipping Sodbury for the benefit of the local farmers and gentry. Now

it is important to understand that engineers have to fight against many things in their professional life but one of the most important is the Force of Gravity. We spend hours, weeks, years devising ways of cheating the Force of Gravity.

All the time in the Crabtree Century new discoveries were being made. Following Robert Hooke's important law "Ut tension sic vis" appeared in 1810 the shattering headlines in the Chipping Sodbury Times "Young's modulus discovered". I say 1810 because Thomas Young had in 1807 sent to their Lordships in the Admiralty, of all places, a letter which read as follows.

*The modulus of the elasticity of any substance is a column of the same substance, capable of producing a pressure on its base which is to the weight causing a certain degree of compression as the length of the substance is to the diminution of its length.*

To this perfectly plausible missive their Lordships replied as follows,

*Though science is much respected by their Lordships and your paper is much esteemed, it is too learned...in short it is not understood*

thus holding back the advance of engineering by at least three years. Young himself departed for Egypt, taking on the, relatively simple task of deciphering Egyptian hieroglyphics. But I digress again .

Joseph Crabtree had of course seen the many cast iron structures being built at the time. The first cast iron bridge was that built in Coalbrookdale in 1779. On his visits to construction sites he no doubt found it a source of great embarrassment that he was not an engineer and would be talked down to by those in that noble profession. However, it is well-known that he was a Freemason so when he was asked whether he was an engineer he could quite honestly answer, "Not an engineer, but I am a Mason". So this is how Crabtree entered the professions of building and engineering. He soon acquired considerable knowledge of engineering matters through his travels and visits to construction sites and through his voracious reading. One of the phenomena he would have noticed was that many of the iron castings were riddled with blow holes arising from gases in the molten iron. Well even the artists among us here tonight will probably realize that a hole has both a weakening and an unsightly effect. But these holes could be filled, and it was to this problem that Crabtree applied his deep understanding of chemistry. The filling had to set hard and be capable of being smoothed, disguised and painted over so that the ignorant public would not raise embarrassing questions. We all know that chemistry and cooking have much in common and after a while a concoction was devised. It consisted of 35.72% beeswax, 32.81% fiddler's rosin, 22.65% of the finest iron filings and the remaining 8.82% was lamp black. This mixture was heated in a pot by using a red hot bar to melt it and it set like metal.

We now know that when these precise proportions are used the conglomerate forms a giant cross-linked molecule similar to the process which takes place in some modern plastics. Crabtree, realizing this subtle point in anticipation of modern polymer chemistry, personally supervised the use of "Crabtree's Dope" as it was then called. Unfortunately the world is full of unscrupulous people and after his death in the late 1870's there were certain similar problems with the castings of the Tay Bridge. The foreman moulder was a Mr. Fergus Ferguson. I quote, "Against the ignorance of all others in the shop Mr. Ferguson's knowledge seemed great and they

left the works in his hands”. But as we shall see Ferguson’s feet were of clay. The bridge collapsed on the night of December 28th 1879 when a train passed on to its girders while a violent storm raged. The enquiry held after the collapse revealed that Ferguson had “borrowed” Crabtree’s recipe, and, ignorant of the importance of cross—linked molecules, had thrown in a few more teaspoonsful (or teaspoonfuls for those who prefer it that way) of the various components for good luck. Like my mother’s cakes it was a flop. Indeed I believe that my mother’s cakes were nearer to giant cross linked molecules than Ferguson’s mixture. Not only that but Ferguson was guilty of the heinous crime of plagiarism, renaming “Crabtree’s Dope” as “Beaumont Egg” so as to hide its real source.

Just to round off this part of my revelations I would like you to share with me the reverence of the most famous of the Scottish Bards, William McGonagall, for the engineers who built the bridge leaving aside Mr. Ferguson. Before the collapse he wrote

*Beautiful Railway Bridge of the Silvery Tay!  
With your numerous arches and pillars in so grand array,  
and your central girders which seem to the eye,  
To be almost towering to the sky.  
The greatest wonder of the day,  
and a great beautification to the River Tay,  
Most beautiful to be seen,  
Near by Dundee and the Magdalen Green.*

*Beautiful Railway Bridge of the Silvery Tay!  
That has caused the Emperor of Brazil to leave  
His home far away, incognito in his dress,  
and view thee ere he passed along to Inverness.*

*Beautiful Railway Bridge of the Silvery Tay!  
Which will cause great rejoicing on the opening day,  
And hundreds of people will come from far away.  
Also the Queen, most gorgeous to be seen,  
Near by Dundee and the Magdalen Green.*

*Beautiful Railway Bridge of the Silvery Tay!  
and prosperity to Provost Cox, who has given  
Thirty thousand pounds and upwards away  
In helping to erect the bridge of the Tay.  
Most handsome to be seen,  
Near by Dundee and the Magdalen Green.*

*Beautiful Railway Bridge of the Silvery Tay!  
and prosperity to Messrs Bouche and Gothe  
The famous engineers of the present day,  
Who succeeded in erecting the Railway  
Bridge of the Silvery Tay.  
Which stands unequalled to be seen*

*Near by Dundee and the Magdalen Green.*

After the collapse McGonagall was urged to offer the following advice to bridge builders who of course have since then always reminded themselves of his great wisdom in hindsight.

*Oh! ill-fated Bridge of the Silvery Tay,  
I must now conclude my lay  
By telling the world fearlessly without the least dismay,  
That your central girders would not have given way,  
At least many sensible men do say,  
Had they been supported on each side with buttresses,  
At least many sensible men confesses,  
For the stronger we our houses do build,  
The less chance we have of being killed*

I myself always keep this wonderful advice before me, having had it engraved above my door. I find it a great educational aid for my students who hold McGonagall's name in almost the same reverence as Joseph Crabtree.

Well that was one battle against the Force of Gravity which the engineers lost.

Let me now turn to Crabtree's time in Australia during his round-the-world tour. At the time of his arrival very little was known about the Inverse Force of Gravity so this country was indeed fortunate in having an expert on the Force of Gravity step on to its shore at such an early stage in its life. The Force of Gravity in the northern hemisphere was well understood because everything either falls downwards or presses downwards on the Earth. Was this also true in the southern hemisphere? As there were no crab-apple trees in Australia at that time it must have been necessary to carry out the experiments by other means. Unfortunately we have no records of these experiments but we do know that Crabtree, who had by then been appointed as the Queen's Royal Gravitational Surveyor, was able to pronounce that in Australia all things will always fall downwards, that is upwards.

There is an interesting theory about Crabtree's short visit to Melbourne in his capacity as the Q.R.G.S. but the records are sketchy to say the least. His measurements showed that the further down the Yarra River one travels the greater is the force of gravity. I know this to be true because it is always the case that I feel a heavy heart whenever I visit that dreary part of Greater Melbourne. I began to think about this and weighed the evidence. Melbourne has had two bridge collapses and both were in that part of the region. Although at the two Royal Commissions there were various theories about brittle fracture and buckling of the steel plates these are red herrings because the coincidence of two collapses in the same region is too great. It is quite clear that Crabtree was right and the Force of Gravity must be greater than the two engineering teams had allowed for. Crabtree's valuable results had been ignored or lost. I then asked myself why should there be this local aberration in the Force of Gravity. I stumbled on what. Crabtree must have known but kept *very* close to his chest. Archimedes discovered his law in the bath, my revelation came to me under the shower. My instinctive response was to shout "Eureka" but being a modest fellow and it being the middle of Melbourne's winter I did not run down Clayton Road in the nude.

The inverse square law of gravitational attraction states that the force of attraction between two bodies is proportional to the product of the masses and the inverse of the square of the distance between the bodies. Thus if the gravitational force pulling the bridge downwards (or upwards) is indeed greater in that region there must be a very large underground body of high density material to the west of Melbourne. What we now know is that Crabtree had convinced himself of enormous bodies of gold to the west of the city. It is hard to imagine that the effect from the Ballarat Goldfield would be significant and besides the bridges collapsed in 1963 and 1970 'by which time this field had been exhausted. Thus we who pin our flag to the Crabtree mast know that down there somewhere are riches beyond our wildest dreams simply to be dug up and used to pave the streets of our glorious city.

For the benefit of those who did not have the benefit of a classical education let me now briefly explain why "Eureka" was the appropriate word for both Archimedes and myself to shout in these circumstances. Archimedes had discovered a way of detecting the adulteration of the gold in Hiero's crown. I had discovered Crabtree's secret about huge volumes of gold to the west of Melbourne and because of the similarities in the two situations I think that you will agree that "Eureka" is not only the most suitable word, but it is indeed the only word to use on such occasions.

It is the duty of an historian not only to present a few facts, carefully selected to suit whatever thesis he or she is pushing at the time, but also to interpret those facts and place them into the post-surrealistic picture he or she has in mind. It is therefore my task to try to rank Crabtree in the world of technologists of his day. I claim that he is a man of greater significance than George and Robert Stephenson, Isambard Kingdom Brunel, John Smeaton and so on. They were men of numbers, rather like bookies' clerks who understood the mysteries of addition, subtraction and even long division. Crabtree's world transcended long division; a man with his insight need only lick the finger and hold it up to know which way the wind was blowing. I see Crabtree, and that most eminent of engineering innovators, none other than Heath Robinson, as the true leaders in the art of technology. But we, the disciples of the greatest, do not need to state what we already know as to which one out of Crabtree and Robinson lead and which one followed.

I was going to tell you about my discoveries of Crabtree's brief sojourn in Siam on his way back to England from Australia but the hour is late and my researches are incomplete. The reason for this is partly that it took me much time and effort before I discovered that he had Siamesed his name. Crab was treated quite rightly as an adjective and tree as the noun. In Thai, as in many languages, the noun precedes the adjective so he introduced himself as "Tree crab" which in Thai becomes My Poo. I leave this valuable clue with you in case some future orator follows the thread to that exotic part of the world.

In closing, this has been a singular honour for me. I am sure that my former history teacher would be most surprised to learn that I have actually delivered a learned paper in that branch of knowledge.