

The Crabtree Foundation (Australian Chapter)  
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*Joseph Crabtree: The Einstein Connection*

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Gentlemen, I stand before you - a physicist in a distinguished Company. Not that physicists are just like everyone else. Physicists are not regular fellows - and neither are poets. Anyone engaged in an activity that makes great demands on both the intellect and the emotions is likely to be a little odd. Like many poets, the physicist is looking for *truth* and that is my task tonight. We seek the truth about Joseph Crabtree and his contributions to Science. The truth is that Crabtree is much less known as a scientist than he was as a poet. This gap in our knowledge provides an area for research which is rich in possibilities so that we must not be surprised when the truth is revealed .

Modern science began with Isaac Newton and reached its highest point with Albert Einstein. Of the 152 years separating the death of the former and the birth of the latter, Joseph Crabtree's lifetime spanned the middle hundred years. Crabtree became a devout champion of Newton, not only as a proud Englishman, but to his credit, he had read much of Newton's work and appreciated its beauty. It has not been reported that Crabtree's favourite couplet was

*Nature and Nature's laws lay hid in night:  
God said, Let Newton be! and all was light.*

which he would use to finish any discussion he might have where he felt that Newtonian ideas were being attacked. It has been reported that Crabtree was much taken by Newton's experiments with flying lantern-borne kites and that he repeated these - dangling a kite over the Chipping Sodbury Woods at night. This had a dramatic effect on the occupants of the woods particularly among the courting couples and probably gave rise to the phrase *Never again, I've seen the light*.

Crabtree's stout defence of Newton is now well documented including his prompting of Lord Brougham to attack Young's Wave Theory of Light in the Edinburgh Review. Actually there has been some controversy as to whether Crabtree ever visited Scotland. Let me put this straight. Robert Burns was five years Crabtree's junior and it is in Burns' poetry that we find evidence of the visitation. I quote

*As I cam down by Annan side  
Intending for the border,  
Among the Scroggie banks and braes  
Who met I but a trogger.  
He laid me down upon my back,  
I thought he was but jokin',  
Till he was in me to the hilts,  
O the deevil tak sic troggin!*

This probably needs a little translation. A trogger was a pedlar or travelling salesman. To the young 18th century Scot, Englishmen were either excisemen or salesmen. The former were quickly exterminated while the latter were tolerated. This particular Englishman is a very fast worker who very rapidly woos and subdues the maiden who tells the story. The poem goes on

*What could I say, what could I do,  
I bann'd and sair misca'd him,  
But whiltie-whaltie gaid his a...e,  
The mair that I forbade him:  
He stell'd his foot against a stone,  
And doubl'd ilka stroke in,  
Till I gaid daft among his hands,  
O the deevil tak sic troggin!*

This requires no translation!  
The final verse is

*Then up we raise, and took the road,  
And in by Ecclefechan,.  
Where the brandy-stoup we gart it clink,  
And the strang-beer ream the quech in.  
Bedown the bents o' Bonshaw braes,  
We took the parting yokin';  
But I've claw'd a sairy c.... sinsyne,  
O the deevil tak sic troggin!*

Here the trogger and his companion live it up in the local pub before taking a fond and loving farewell leaving a somewhat bemused and bruised story-teller.

Of course the story within the poem tells of a whirlwind tour of Southern Scotland by Joseph Crabtree in 1779. Crabtree would have sought out the young poet and Burns is at first overwhelmed (laid down upon his back) by the sheer strength of Crabtree's personality and his zest for life. He soon falls in with the visitor's ways and they have many joyous sessions, becoming firm friends. Burns is left with an unforgettable impression of a lifestyle he had not previously encountered, sold to him by the master salesman, Joseph Crabtree.

Burns remains supreme as Scotland's greatest poet, but he is also known for his collection of bawdy songs which were first published anonymously in 1799, a year after Burns' death. Crabtree would have ensured that they were published. No doubt some, at least, of the Merry Muses were composed during or inspired by that tour twenty years before.

To return to our main task, we turn to the most basic and fundamental of Newtonian concepts, those dealing with space and time. Newton had much difficulty with these, he could not find a suitable frame of reference with respect to which his famous laws would be true. So he postulated an Absolute space and an Absolute Time which existed without reference to anything whatsoever and relative to which his laws of mechanics were true. As Einstein said later:- *Newton himself was better aware of the weaknesses inherent in his intellectual edifice than the generations which followed him. This fact was always roused by admiration.* But to Crabtree, Newton's word was law and he took it upon himself to be the guardian of the law. We have heard that Crabtree usually carried a walking stick - often used as a weapon. This was richly carved and carried a number of notches scattered along its length at irregular intervals. While some may speculate as to their significance I can reveal that they could be used to settle all arguments involving measures of length by stating that the markings were referred to Newton's Absolute space and so gave indisputable measures of the inch, the foot, the metre according to which marks were used. And only Crabtree knew which were the appropriate notches. Of course the choice of notches could vary depending on whether our hero was buying or selling!

Crabtree was quick to note that the concept of Absolute Time was even more convenient and it became the time shown on his watch. On arriving two hours late for an important engagement he would pull out his watch and declare “Ah! I see I am ten minutes early” Of course the watch had no working parts other than hand adjustments but with Newton behind him and walking stick in hand who could argue? Thus time was conquered and became Crabtree’s slave as it should be. It is small wonder that Crabtree was such an ardent admirer of Newton. He was so impressed with his mastery of time that he made a patent application covering the design of his Absolute Time watch. Where else would he file his application than with the Swiss Patent Office? Of course the papers were quickly consigned to the Cuckoo Basket.

Albert Einstein’s early life has been closely examined and recorded - even the marks he obtained in school examinations. We find his early education somewhat disjointed but he was admitted to the Federal Institute of Technology in Zurich as a student at age 17 and obtained his diploma in the year 1900. He existed for the next two years partly on family support and on income from private tutoring in mathematics and physics. His first job came in 1902 when he was appointed as a Technical Expert, Third Class at the Patent Office in Berne. Then follows an incredible three year period during, which Einstein married, fathered his first son, completed his PhD Thesis *On a New Determination of Molecular Dimensions*, completed his paper on the light-quantum hypothesis, submitted his two papers on Brownian motion and his two papers on Special Relativity.

While much of this work was in areas being explored by his contemporaries Einstein’s contributions through the Theory of Relativity were unique. His realization that time and space needed to be defined and his definitions which led ultimately to  $E = MC^2$  were truly inspired. In seeking the source of inspiration Einstein recalls that the type of critical reasoning necessary he found in things he had read and he mentions the philosophical works of Hume and Mach. Why not what he found in the Cuckoo Basket at the Patent Office? No doubt he would be required to deal with this as the new boy at the office. Einstein’s operational definitions for time and space are of course beautifully precise and their application leads inevitably to the phenomena of time dilation and length contraction but he also gave whimsical explanations. On being asked to explain time dilation to a friend Einstein said .

*... It’s like going to the dentist. You have to sit in the waiting room for ten minutes. It seems like half an hour. Back at the office your secretary sits on your knee for half an hour. It seems like ten minutes.*

Crabtree’s watch could turn half an hour into ten minutes any time he felt like it!

Finally, it is interesting to speculate about the origin of the initial letter  $C$  for the speed of light, one of the most fundamental and best known physical constants. This was first measured with surprising accuracy by Römer in 1676 and was called the velocity of light with the initial letter  $v$ . R6nier’s measurement used telescopic observations of the motion of heavenly bodies. The first laboratory measurement of the velocity of light was that of Fizeau in 1849 but again no  $C$  was attached to it. In the latter years of Crabtree’s life there were many investigations being carried out in electromagnetism and among these was the work of Joseph Weber in Leipzig where measurements were made of the force acting on an electric charge moving in a magnetic field. This force was found to be proportional to the magnitude and velocity of the charge and to the magnetic field. Nothing inverse square about this force. Crabtree would have been delighted and the researchers relieved for Crabtree’s violent attacks on inverse square phenomena in electromagnetism were well known. Weber measured the constant of proportionality which he called  $c$  in the force equation and published his results in 1856, two years after Crabtree had passed on. Weber’s work has been immortalised by using his name for the unit of magnetic flux but Weber’s constant remained simply  $c$  for fifteen years or so. It took the genius of James Clerk

Maxwell, another famous Scot, to identify Weber's electromagnetic constant with the velocity of light which thereafter took  $c$  as its physical symbol.

Who can deny that Weber's choice of  $c$  for this constant was no coincidence. The work was carried out in the last days of Crabtree's life and published just after his death. Of course at the time Weber could not have known just how significant this constant would become but the choice of Crabtree's initial is a fitting tribute to the influence exerted by Joseph Crabtree on 18th, 19th and 20th century science.

*Chronology*

Newton	1642—1727
Römer	1676 ( <i>speed of light</i> )
Crabtree	1754—1854
Burns	1759—1798
Fizeau	1849 ( <i>speed of light</i> )
Weber	1856 ( <i>constant <math>c</math></i> )
Maxwell	1873 ( <i>Treatise on Electromagnetism</i> )