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Cycling and Disability

By Kevin Hickman and Isabelle Clement, London, England

Cycles have been used as mobility aids by disabled people throughout the history of cycling and there are good reasons to believe this will continue long into the future. However, this connection is not generally well-known and is possibly obscured by a strong association between disabled people's mobility and the wheelchair. By comparing modern mobility aids with their counterparts from the 17th and 19th centuries we can see a strong connection between cycling and disability and perhaps some clues as to why that is not common knowledge.

Figure 1. Stephan Farffler and his Manumotive Tricycle, c.1655

Stephan Farffler was a disabled clockmaker who lived in Altdorf, near Nuremburg, in Germany. Between 1655 and 1680, he designed and built, or had built for him, the machine illustrated in **Figure 1**. Glenn Norcliffe has described this machine thusly: [1]

Farffler's manumotive tricycle is the world's first authenticated tricycle, though it is possible there were earlier tricycles for which no reliable record survives."

Focusing on Farffler rather than on his invention, that statement can be extended to say that Farffler is the world's first authenticated cyclist, and further, that the world's first authenticated cyclist was a disabled person.

We are not aware of any contemporary descriptions of Farffler using his manumotive tricycle in or around Altdorf during his lifetime, but by comparing it to the experience of a disabled person using a modern handcycle, we can speculate how practicable his invention would have been at that time.

Isabelle Clement (an author of this article who is herself disabled) became aware of handcycles while looking for a way to keep up with her 4 year old after he was given his first bike. She faced the prospect of him cycling away from her, out of reach, in environments where a wheelchair is slower and of limited use; across grass, along gravel paths, up and down hills. While researching mobility scooters she came across the 'clip-on' handcycle, and it was a discovery that changed her life. **[Figure 2]** Recently, Isabelle spent a week on a car-free island, something she would never have imagined doing before becoming a handcyclist. Now she commutes to work by cycle in Brixton, South London, and is able to access places in Central London where there is no disabled car parking or where it is in short supply and oversubscribed.

Having originally conceptualized the handcycle as an extension of her wheelchair, it was sometime before Isabelle realized that she was sharing the same space and having similar experiences as other cyclists, and she began to equate what she was doing with cycling. With this understanding came the further realization that this overlap between wheelchairs and cycles used by disabled people began as early as Stephan Farffler's manumotive tricycle, which is also considered to be the first authenticated self-propelled wheelchair.[2]

It is reasonable to speculate that Farffler's invention was born out of a desire to improve his own mobility, coupled with his technical know-how as a clockmaker. Based on the gearing and a hand turned crank cadence of 50 rpm, Glenn Norcliffe has estimated the speed of Farffler's single gear tricycle to be a slow walking pace of approximately 2 miles per hour.[3] We don't know how fast, how far, by what method, or with what level of difficulty he moved around Altdorf, but it is reasonable to surmise that Farffler hoped to improve on these parameters with his invention. Factors that would have affected the gearing were his strength, his own weight, and the weight of the tricycle which must have been considerable given it was constructed using wood and iron. Add to that the likely rough state of the surfaces he would have been traversing, and it is not difficult to understand why the application of his invention effectively died with him. Compared to Isabelle's modern handcycle, Farffler's potentially revolutionary concept was unable to benefit from today's lightweight materials formed into efficient shapes, pneumatic tyres that afford better traction and rider comfort, variable gears to enable changing torque and speed as conditions require, and most recently, electric assist to allow greater range in hilly terrain for a machine that is by its very nature heavier than a standard bicycle. It is fair to say

Figure 2. Isabelle Clement and her 'Clip-on' Handcycle, 2017 (Bruce Basudde, Bruce Photography)

that despite the remarkable similarity in form with today's handcycle, Farffler's concept was several centuries ahead of its time as far as being a practical solution for improving mobility.

Moving on to the second half of the 19th century when cycle design was probably at its most diverse and frenetic, the archives are relatively rich with information and contemporary comment. One of Singer & Co.'s versions of the Reverend RH Charsley's manumotive tricycle which he christened the Velociman is shown in **Figure 3**. Charsley invented and first patented this machine in 1869, and Singer & Co. of Coventry manufactured variations of it between 1880 and 1913. With a possible, but probably unintentional, reference to Farffler's machine, Charsley's machine was described in *The Tricyclist* in 1882: [4]

From time immemorial, if we may so speak of time since the introduction of the tricycle, machines have been made for manumotive purposes. Indeed most of the earlier tricycles were so constructed, the general arrangement being simply the fitting of hand levers to the double-cranked axle shaft. Few, however, were capable of any speed, or even of any practicable utility until some ten years since, when the Charsley Velociman was introduced, and at that time had a great run, and took a foremost position amongst the machines of the day. It was a most simple machine and fairly effective, but with the advance of time and the improvements in construction of the modern machines, it gradually fell into disuse, and was relegated to the limbo of things of a bygone age. Last year, however, Mr Charsley, who seems never to have dropped the idea of a manumotive machine entirely, again gave the matter his serious attention, and succeeded in introducing the machine now under notice, which is certainly a vast improvement upon anything previously introduced in the manumotive line.

This article goes on to describe the method of propulsion where the rider operates the levers together using an action similar to rowing, pushing forward, down, pulling back, up and then pushing forward again in a repeated elliptical motion. Following repeated requests Charsley himself gave a description of its operation in an article published in *English Mechanic and World of Science* in 1882, along with calculations and a comparison of his Velociman with an 'ordinary tricycle': [5]

The proportion then of the power of the two tricycles in favour of the Velociman, when one foot only is used, is a little more than 5:1. Can it be wondered at, then, that the Velociman will mount hills which no other tricycle can touch?

With the phrase "when one foot only is used" Charsley is referring to his second patent of 1880 which adds a means of partial foot propulsion for the 'down stroke' of the rowing action, presumably to maximise the efficiency of the Velociman for people who still had the use of one or more of their lower limbs. Within the many testimonials collected by Singer & Co. praising the machine, there are frequent references to its suitability in hilly terrian.

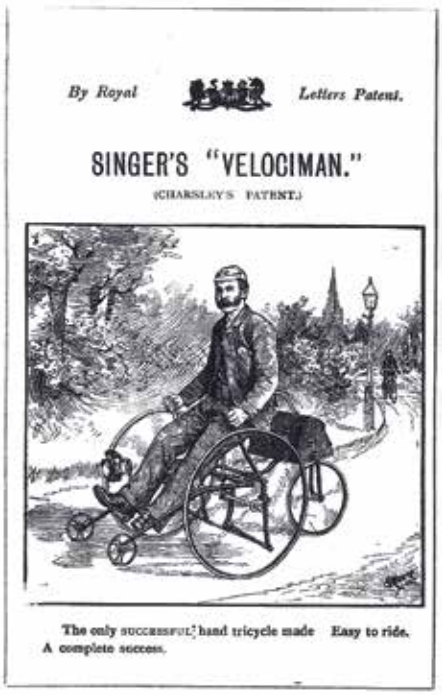

Figure 3. Singer's Velociman from Singer & Co's 1892 Catalogue

In a letter to *The Bazaar*, FJT writes:

Some three and a half years since, I lost my feet while crossing the Great Western Railway here, and on leaving the infirmary purchased a "Velociman", which I have used daily since. I go about the city to my business, and occasionally take short rides into the country. Moderate hills are easily overcome, with, of course, a little extra exertion, and I have every reason to be thankful that such an excellent carriage has been invented. Indeed I do not know what I should have done without it.

Charsley himself wrote to *The Hastings Chronicle*, perhaps not surprisingly as its inventor, praising the Velociman's suitability over longer distances:

I find the Velociman more useful everyday. The exercise is most exhilarating. I came down to Oxford in it from the London-bridge station on the Saturday after I left Brighton. The distance is 60 miles.

Although it was a boon to many people with a lower limb impairment, the use of both the Velociman, and manumotive carriages in general, were not limited to people with a disability at that time: Indeed, 'rowing carriages' appear to have been quite fashionable during this period. Lewis Carroll, author of *Alice Through the Looking Glass* and resident of Christ Church, Oxford at the time, is an example of one who actually went for a spin on a Velociman with its inventor. From Carroll's diary of 1882:

June 1st, Thursday. Went out with Charsley, and did four miles on one of his Velocimans, very pleasantly.

June 3rd, Saturday. Sent Charsley a description, with drawings, of a plan that has occurred to me for improving the steering, by horizontal wheels, and a chain round them. The improvements will be (1) movable 'back' travels on a concave instead of convex lines; (2) motion needed is less; (3) you lean the way you want to turn, which is instinctive and safer as to upsetting.

It sounds like Carroll was steering the Velociman by moving his back left and right which meant he was leaning away from the direction of turn, whereas we think Charsley intended the rider to steer by twisting his back so that one rolled against the backrest, facing into the turn. Anyway, no changes were made to the steering which was one of the few aspects of the Velociman that remained the same throughout its life in production.

Charsley refined his design further with a third patent in 1890 which suggests that as cycle design developed during the 1880s, manumotive propulsion became less popular and at the same time became more associated with disability. This extract from *Bicycling News* in 1891,[6] gives some background to the Reverend RH Charsley himself and his lastest modification:

After several years of engineering, Mr Charsley determined to qualify himself for the MA degree at Oxford.

This he did, graduating in very high mathematical honours. The sequel is, in a measure, known to the public. Although he has changed his profession, the love for anything mechanical has never forsaken him. When in the year 1868-69 the bicycle was introduced into England, he bethought himself how he might do something for the lame people under his charge (he was chaplain of the Radcliffe Infirmary, Oxford), in the way of locomotion. Hence his first crude tricycle, the "Velociman", lately exhibited among the old crocks at the Stanley Show. This machine was used at the time by many lame people, but now Mr Charsley has the further desire to dissociate the "Velociman" from lame people by giving the excellent principle of hand movement in the "Velociman" to assist ordinary riders of pedal machines. The new form is called the "Manupede." The character of the "Velociman" is retained, but a foot rotary pedal motion is added, and is so arranged that the foot motion gives a purchase to the rower, while the lever-rowing motion gives a purchase to the pedaller.

As far as we know, Singer & Co. never manufactured a Velociman with foot operated rotary pedals, and we wonder whether rowing with the arms while pedalling with the feet was akin to patting one's head while rubbing one's tummy - an exercise in concentration and coordination. Singer & Co.'s final version of the Velociman, from 1896 into the 20th century, with smaller diameter driving wheels and pneumatic tyres is remarkably similar to a present day manumotive tricycle, the Mountain Trike, shown in **Figure 4** being demonstrated by its inventor Tim Morgan at the 2013 Cycle Show in Birmingham.

Lewis Carroll would likely have preferred the Mountain Trike's steering arrangement. The rear wheel is turned by cables which are controlled by moving the end of one of the hand levers from side to side in the direction you want to turn. The steering lever can be mounted on the left or right side.

The drive isn't continuous as it is for the Velociman, the levers only drive the wheels during the forward stroke, each lever being connected to its driving wheel by a chain and a freewheel which allows the lever to be pulled back quickly for the next driving stroke. The components, including the disk brakes, brake levers, shock absorbers and wheels are all standard MTB components.

Figure 4. The Mountain Trike, exhibited at the 2012 Cycle Show, Birmingham, England. (Kevin Hickman)

The Mountain Trike is designed and geared specifically for off-road riding over very rough terrain and there are many testimonials from happy customers who say this is the first thing they've found that enables them to do that.[6,7] And despite having the outward appearance of a wheelchair, the Mountain Trike is used to ride, or to ramble, in the Peak District and the Yorkshire Dales by a group affiliated to a national cycling club.[8]

Conclusion

During the course of writing this paper it has become clear to us that very few people are aware that a disabled person invented what is generally considered to be the first cycle, or that the cycle was invented in the 17th century long before the bicycle. We cannot say conclusively why that is the case, but it is reflected in the two main fronts on which "Wheels for Wellbeing" spends most of its time. The first is convincing disabled people that they can cycle, because few are aware that it is possible, and the second is convincing everyone else, from family members to government ministers, that disabled people can, and do, cycle, and that disabled people need to be included in cycling policy and design guidance. History shows that disabled people can and always have cycled, but despite advances in technology that have made Farffler's concept a practical reality, and when the Velociman has to be reinvented as it appears to have been in the form of the Mountain Trike, clearly that history needs to be dusted off and made readily available.

The similarity between the testimonials from users of the Velociman over a hundred years ago and those from users of the Mountain Trike today is striking. Will the Mountain Trike cease production just as the Velociman did despite it being highly valued by its users? We hope not, but a better understanding of what happened to the Velociman in the period leading up to 1913, just before significant numbers of people were returning from a war having lost one or more of their lower limbs, could only help in understanding how to avoid it happening again.

We wonder if part of the explanation for the Velociman's demise lies in the success of the safety bicycle running parallel to it. Surprisingly, Charsley appears to have been concerned about his invention's association with 'the lame', given that this was the main reason for its birth. Did solidifying attitudes because of that association mean a critical mass of new users could not be maintained? And what mobility aid replaced it at the time?

We have more questions than answers at the moment, but in the spirit of this year's conference we are hopeful that a brighter cycling future for disabled people can be found in a better understanding of their cycling past. ●

Acknowledgement

We are grateful to David Hibberd and Constantine Gras for sharing their research into Charsley's Velociman. ●

Endnotes

1 Norcliffe, Glenn (2011). "Before Geography? Early Tricycles in the Age of Mechanicians", *Proceedings of the 22nd International Cycling History Conference*, p. 88.

2 Brian Woods and Nick Watson. "History of the wheelchair", *Encyclopedia Britannica,* https://www.britannica.com/topic/history-of-the-wheelchair-1971423. Accessed 16 August 2018.

3 See Endnote 1.

4 "Wheels. By the Author of *The Tricyclist's Indispensable Annual.*" *The Tricyclist*, 21st July 1882, p. 37.

5 Charsley, RH. "The patent improved Velociman or Manupede", *English Mechanic and World of Science: No. 881*, 10 February 1882, p. 544.

6 "The Inventor of the "Velociman", *Bicycling News*, 14th February 1891.

7 http://www.mountaintrike.com/testimonials, Accessed 16 August 2018.

8 Joyce, Dan. "Craig Grimes, CTC & Me", *Cycle*, June/July 2015, https://www.cyclinguk.org/sites/default/files/document/migrated/publication/201507032.pdf, Accessed 16 August 2018.