

## Harry J. Lawson's 1873/1874 Sussex Dwarf Safety Bicycle: The First Chain Driven Rear Wheel "Safety" Bicycle

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To begin, it is important to know that the question of whether Harry J. Lawson's 1873/1874 Sussex Dwarf Safety Bicycle [Figure 1] was ever built by Harry J. Lawson has been hotly contested by two of the giants in the field of Cycling History; namely the late Derek Roberts arguing "NO, HE DID NOT", and Nicholas Clayton arguing "YES, HE DID". The answer to this argument is important because if Harry J. Lawson did design and build the "Sussex Dwarf" as he claimed, Harry J. Lawson could rightly be celebrated as the original, first inventor of a true "Safety Bicycle", instead of James Starley who designed and invented the "Rover" [Figure 2] that has generally been considered to be the first "Safety Bicycle" up till now (i.e., 2022). These Safety Bicycles were invented/designed to replace the High Wheeler bicycles [Figure 3] that were so popular, and dominant, at that time

While this paper was written by the above-named author, the title of the paper had been put forth by Nicholas Clayton

some time earlier when he was intending to participate in the 31st International Cycling History Conference (31st ICHC) at which I, the author of this paper, presumed Nick would have presented a paper on the subject of this paper. Subsequently, Nick decided not to participate in this Conference for personal reasons. However, the story did not end there because I, the author, attended the 2022 International Veteran Cycle Association (IVCA) Rally that took place in Oostende, Belgium, on 26-29 May 2022 where I met Edwin Knight and learned about his recent 'BUILD' of Lawson's Sussex Dwarf [Figure 4] and the good riding characteristics of this 'Safety' bicycle that was built to the 'Drawings' of the Sussex Dwarf and the 'Notes' that Harry J. Lawson had drawn and penned in 1900 at London's Science Museum. With the information that I gained from talking to Edwin Knight and knowing that Nick would not be at the 31st ICHC to favor us with his thoughts on the subject (one of Nick's favorites), I decided to do some research and write this paper.

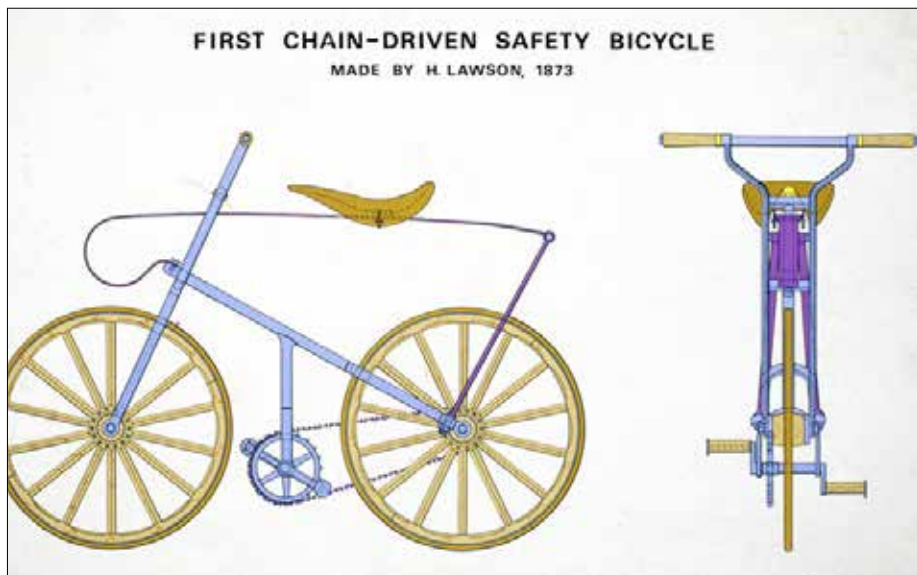


Figure 1. Drawing of Harry J. Lawson's 'Sussex Dwarf Safety Bicycle of 1873/1874' made by the Staff at the Science Museum in London, England, from drawings made by Lawson in 1900 during a visit to this Museum.



Figure 2. An Advertisement for Starley's Safety Bicycle introduced to the public at the Stanley Show in London, England, in 1885. Up until recently, this bicycle has been generally acknowledged to be the first true "Safety Bicycle" made in the world. However, research by cycle historians has uncovered information revealing that Harry J. Lawson was the first person to design, build, and ride a true 'Safety Bicycle'. The evidence for the Claim that Lawson was actually the first person to Design, Build, and Ride a true Safety Bicycle is outlined in this article and in an earlier authoritative article by Nick Clayton (Clayton, Nick (2020), *The Boneshaker*, No. 214, p.8-21.)

### WHO WAS HARRY J. LAWSON?

First, let's examine who Harry J. Lawson [Figure 5] was and especially his competency as an inventor and builder of bicycles. Lawson was born in 1852 In London, England. H. O. Duncan<sup>1</sup> tells us that Lawson apprenticed to a practical engineer in 1868-69 during which Lawson commenced thinking about making a safety bicycle. Lawson, in his own words:

*"There was no bicycle of any kind when as a boy. I made my first safety out of my perambulator, which had two very straight and very strong 23-inch back wheels. I got the first idea of a bicycle from my father whose idea was the feature of sitting low with one's feet on the ground. Father's ideas were wrong as to hand power: I learned that the legs were best by experiment."*

Thomas Lawson, Harry's father, was a Calvinist Methodist minister and a brass turner who had also served as a curator at the Transport Museum in London where he oversaw the exhibition devoted to George Stephenson (1781-1848) and his invention of the "Rocket" Locomotive<sup>2</sup> that gave rise

to the first railroads in the world. Lawson spent time in this museum where he developed an interest in vehicles that moved people and things, and the mechanics involved in the operation of these vehicles. Thomas Lawson moved his family to Brighton in 1873 to become the Puritan preacher at the Brooks Chapel and the Royal Pavilion Palace at Brighton, a position that he famously held for 33 years. When in Brighton, Harry Lawson worked on the invention of a Safety Bicycle that came to be called the Sussex Dwarf [Figure 1] because of its small wheels (23-inch diameter). This bicycle will be discussed in more detail later in this paper. In 1878, Harry married and moved to Coventry where he worked in the bicycle making industry that was based there, and in 1879 he became the Managing Director, the Rudge Bicycle Co. When in Coventry, Lawson developed a progression of Safety Bicycles [Figure 6] including one named “Bicyclette” [Figure 7]. The Bicyclette had only limited sales success, but when sold in France its name was adopted as the name for all safety bicycles in that country. In the 1890’s, Lawson became deeply involved in the development of the new automobile industry in part by using financial schemes that were largely successful. However, one of his partners in many of these schemes



Figure 4. Edwin Knight on his 2020 build of Lawson’s Sussex Dwarf that Lawson designed, built, and rode in Brighton, England, in 1873/1874.

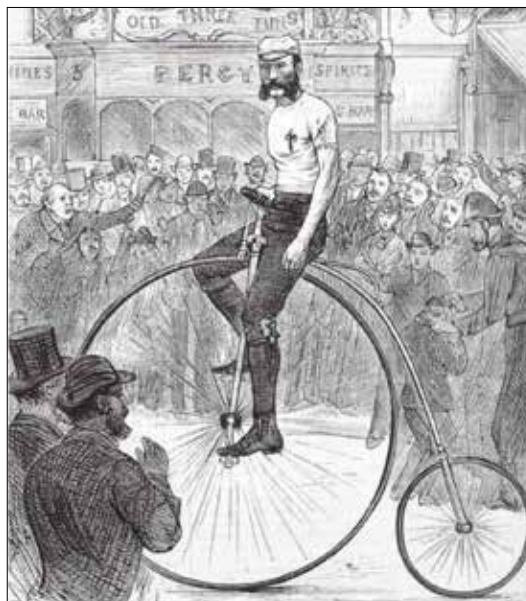


Figure 3. A typical High Wheeler bicycle that was called by many different names such as ‘Penny-Farthing’ and, after safety bicycles became the standard bicycles at the end of the 1880s, ‘Ordinary’.

was Ernest Terrah Hooley who was a prominent ‘Fraudster’<sup>3,4</sup> and this resulted in Lawson being convicted of fraudulent use of investor’s funds, in one case with a sentence of one year at hard labor<sup>5</sup>. Lawson’s involvement in some fraudulent financial schemes with Hooley led Lawson’s detractors to label him a “Fraudulent Schemer”. However, H. O. Duncan, a man who, like Lawson, was well known as a bicycle racer and prominent in the formation of the then new automobile industry, was the author of a two-volume history of wheeled vehicles in the 19th and early 20th Century<sup>6</sup>, and had worked with Lawson for several years on the development of the automobile industry in the United Kingdom. Duncan saw Lawson as “The Most Extraordinary English Pioneer of All the Cycle and Motor Pioneers as Inventor, Promoter, and Manufacturer”. He went on to write this about Lawson:

“Although Lawson may have occasion-

ally become enmeshed in the “gear wheels” of other men’s sins – the victim of fate – he was neither a greedy man nor an egoist. On the contrary, he was always fair and extremely generous.”

After this scandal and Lawson’s 1-year of imprisonment, Harry J. Lawson retired from active participation in industry and was living in (a suburb of London) when he died at over 80 years of age.

### INVENTION and BUILDING OF THE “SUSSEX DWARF”

In 1873 Harry J. Lawson was living in Brighton in the South of England; he was 21 years old; he had a friend named James Likeman that worked with him to develop a Safety Bike; and he and his friend had only a limited amount of money for tools and materials. With these limited assets, these two experimented with designs for a bicycle that would be speedy and “safe”. The dominant bicycle of that time was the “high wheeler” [Figure 3] that was spectacular with many desirable features such as (a) great speed capability, (b) dependability, and (c) relatively low maintenance cost when compared with its main competitor ‘the Horse’.

However, the High Wheeler embodied a high level of danger because the rider sits high in the air close to the machines’ center of gravity so that anything encountered while riding that abruptly stalls the forward motion of the large front wheel will cause the rider to fall forward over the handlebars. [Figure 8] Since the rider’s legs are located under the handlebars, a falling rider is likely to land on his head, which often leads to serious injuries to the unfortunate rider. Also, regarding “speed”, a shorter person is at a disadvantage when riding high wheelers due to the smaller diameter wheels that

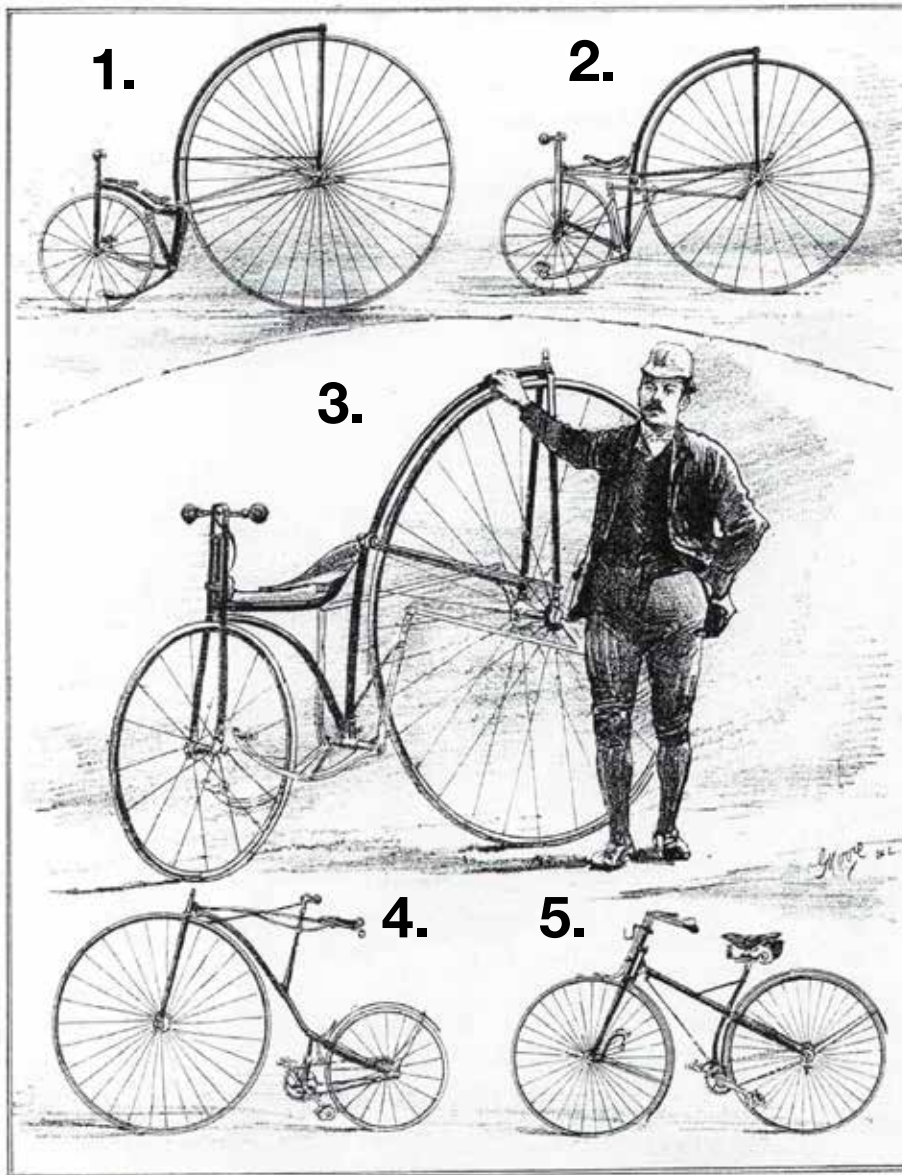


Figure 5. A photograph of Harry J. Lawson in the early 1900s when he was busy working to get an automobile industry started in the United Kingdom.

shorter persons can manage compared to the larger wheels that taller persons can ride because of their longer legs: This, of course, means that taller persons can generally go

# "Bicycling News" Cartoon.

JUNE 18th, 1887.



1. Sussex - Giant 76 inches wheel (1876)
2. Singer's Safety - from Lawson's Patent 1878
3. Lawson's Original Safety - winner of the First Safety Championship
4. Rudge "Bicyclette" 1878 - from Lawson's Patent
5. Rudge "Bicyclette" 1878 - from Lawson's Patent

Figure 6. The most important 'Safety Bicycles' designed by Harry J. Lawson for different bicycle manufacturers in Coventry, England, where he lived and worked in the late 1880 and early 1890s.

faster on high wheelers with larger wheels than shorter persons can go on high wheelers with smaller wheels.

So, the main problems that Lawson and his friend had to solve in the development of a "Safety" bicycle was (1) to get the seat down so that the rider has a shorter distance to fall in case of an accident, and (2) maintain the capability for "speed" that is inherent in a High Wheeler: Getting the rider closer to the ground for "safety" was easy to accomplish by simply finding a place to put the seat closer to the ground but in a place where the rider can still perform all the functions that a rider must do (i.e., steering the bicycle and providing the force to move the bicycle forward at a rapid pace). These problems were not easily solved, but they were solved by Lawson

and his helper ingeniously by (a) making the wheels relatively small (i. e., 23" in diameter) and equal in size, (b) moving the seat to a location midway between the two wheels and low enough so that the rider could sit on the seat and still reach the ground with his feet, (c) tilting the head tube backward so that the handgrips were within reach of the rider while still sitting on the seat, (d) placing the pedals on a small wheel positioned below the rider's seat, (e) making the rear wheel into the driving wheel by making the small wheel



Figure 7. "La Bicyclette" designed by Harry J. Lawson when he worked for the Rudge Cycle Company in Coventry, England, in 1879. These bicycles were sold in France and other countries in Europe, and their name became established in France as the name for all Safety Bicycles thereafter.

under the riders seat into a sprocket with teeth on its periphery and placing a similar sprocket on the outside of the rear wheel's axle hub with a chain connecting these two sprockets, and (f) gearing up the bicycle's driving system by making the pedal carrying sprocket larger than the sprocket on the hub of the rear wheel. [Figures 9, 10, 11, 12] When these features are built into a bicycle in the correct relationships, you have created a 'Safety Bicycle' with wheels that can be geared up to equal the size of the wheels used on high wheelers built for taller persons, and shorter persons are no longer

at a disadvantage for speed capability as far as the bicycle they are riding is concerned.

The product of this work carried out by Harry J. Lawson in 1873/1874 was called "Lawson's Sussex Dwarf" [Figure 1] because the wheels were so small when compared to the High Wheeler [Figure 3]. According to Lawson, he did develop and 'build' a "Sussex Dwarf" with all the features and capabilities of a true "Safety

Bicycle" in 1873/1874, and he rode this newly designed and built 'Safety Bicycle', i.e., his "Sussex Dwarf", around the streets of Brighton while he lived there. No examples of this original Sussex Dwarf from the time of its invention are known to exist today and no patent was obtained for this creation. So how do we know that there ever was a Sussex Dwarf built and ridden on the streets of Brighton in 1873/1874?

**THE CONTROVERSY**

In 1900, for the purpose of confirming Lawson's claims, the Science Museum in London, England, invited Harry J. Lawson to come to the Museum and tell the Museum staff all about the invention and building of the Sussex Dwarf in 1873/1874 that he was claiming to have done; Lawson accepted this invitation, and he visited the Museum in 1900 and spent a few days there explaining his invention, making drawings by hand and from memory of the Sussex Dwarf [Figures 9 & 10] and writing notes about this bicycle. [Figures 11 & 12] The Science Museum took Lawson's drawings and had a draftsman make a professional drawing of the Sussex Dwarf based on Lawson's drawings [Figure 1], and to this day, this drawing hangs on the wall of The Science Museum within a display of early Safety Bicycles.

The question as to whether

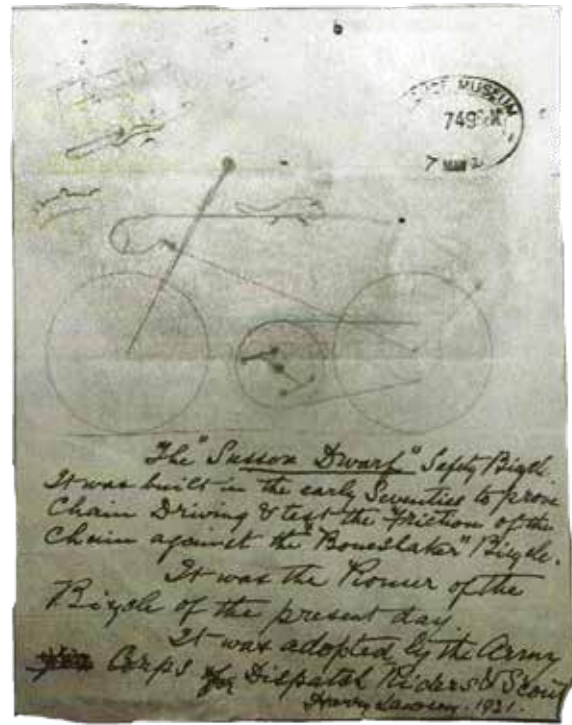


Figure 9. A drawing of the "Sussex Dwarf" made by H.J. Lawson by hand from memory when he visited the Science Museum in London, England, in 1900 at the invitation of this Museum to explain his claim that he was the first in the world to invent a Safety Bicycle in 1873/1874. Note that the only dimension given in this drawing is the size of the wheels that were 23" in diameter. This drawing has been kept in the vaults of the Science Museum since it was made by H.J. Lawson in 1900.

Lawson designed and built a Sussex Dwarf was raised by Derek Roberts in about 1990, when he was on a mission to identify 'myths' related to bicycle history that were circulating in the world at that time, and to make a concerted effort to replace "the myths" with "the truth". As a founder of the Southern Veteran Cycle Club (the SV-CC) that is now The Veteran-Cycle Club (the V-CC), and the First Editor of the authoritative publication *The Boneshaker*, Roberts' position on whether an extant story related to cycling history was "truth" or "myth" carried a lot of weight<sup>7</sup>. One of Roberts' important contributions to the investigation of whether Lawson did or did not design and build a Sussex Dwarf in 1873/1874 was the collection of letters written to the Editor of the weekly magazine *Cycling* from 1 September 1900 and 15 December 1900 concerning the invention of the safety bicycle<sup>8</sup>: All of the letters in this Collection are interesting, but a letter from John Keen [Appendix A] is especially interesting because it tells of a meeting with Harry J. Lawson in Brighton in 1875 when he saw



Figure 8. A high wheel bicycle rider taking a "Header" when the large wheel on his bicycle encountered an object in the road that abruptly slowed the forward motion of his bicycle causing him to pitch forward over the handlebars and to the ground onto his head since the handlebars of his bicycle are across his lap thereby holding back the lower part of his body.

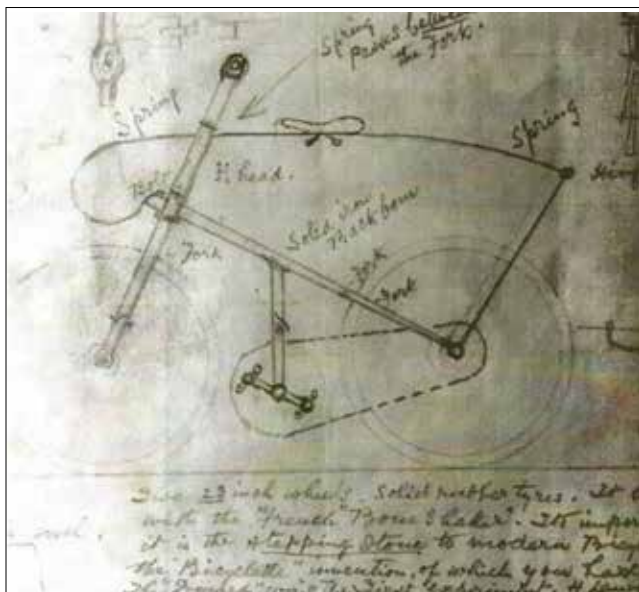


Figure 10. A second drawing of the Sussex Dwarf Safety Bicycle made by hand from memory during his visit to the Science Museum in London, England, during his visit there in 1900. This drawing has been stored in the Museum's vaults since Lawson's visit in 1900.

Lawson in his shop building Safety Bicycles. However, when Roberts examined all the available evidence on “whether Lawson had designed and built a Sussex Dwarf Safety Bicycle in 1873/1874, he decided that there was insufficient evidence to justify the claim that Lawson had designed and built such a safety bicycle in 1873/1874. With this conclusion, Roberts wrote to the Science Museum telling them that they should remove from the Museum all mention, and all illustrations, of a safety bicycle that had come to be called Lawson's Sussex Dwarf. The Directors of the Science Museum disagreed with Robert's conclusions, and they decided to leave all references to Lawson's Sussex Dwarf in the Science Museum as it had been set up following the visit by Harry J. Lawson in 1900.

Following the publication of Roberts' position on Lawson's Sussex Dwarf in 1990<sup>9</sup>, Nick Clayton, one of the most venerate bicycle historians in the world, became interested in the Lawson's Sussex Dwarf, and after examining the existing evidence including the drawing and notes concerning this Safety Bicycle made by Lawson at the Science Museum in 1900 [Figures 9, 10, 11, 12], he concluded that the design of Lawson's Sussex Dwarf would operate well as a bicycle, and that its design did qualify as a Safety Bicycle. Further, Clayton believed that there was no reason to doubt the story told by Lawson about the building and subsequent riding of this Safety Bicycle

Harry J. Lawson in 1873/1874 as Lawson had claimed. To this end, Nick wrote to Cally Calloman, the President of the V-CC in 2018 requesting support for commissioning the building of a Lawson's Sussex Dwarf according to the description left by Lawson at the Science Museum in 1900. The V-CC voted and agreed to support this project. A request for a “Build Proposal” was sent out to several of the skilled builders and restorers of old bicycles and parts, but there were no responders. Edwin Knight in England was one of the bicycle builders who was contacted with this offering, and he had decided to pass on the offer because he was

in 1873/1874<sup>10</sup>. Roberts continued to disagree with Clayton on this issue, so, here we have a controversy about which the two main protagonists could not find grounds for agreement.

### THE 'BUILD' OF A LAWSON'S SUSSEX DWARF BY EDWIN KNIGHT AND ITS PERFORMANCE

Faced with the non-resolvable controversy described above, Nick Clayton decided that a Lawson's Sussex Dwarf should be built to demonstrate that it was in fact a fully functional design which would strengthen his argument that this bicycle was built by

busy with work that had been started earlier, and he had planned to retire. However, the more he thought about the project, the more intrigued he became. Finally, in 2020, Edwin decided to undertake the project only to learn that Nick Clayton had withdrawn his support for the ‘Build’ effort because Derek Roberts had died, which made the controversy a non-controversy. Nick's action in turn led to the V-CC losing its interest in supporting the project. So, now there was no support for building a Lawson's Sussex Dwarf. But, by the end of this lengthy process of trying to get someone to commit to building one of these bicycles, Edwin Knight's interest had reached a point where he decided to go it alone and build a copy of Lawson's Sussex Dwarf with his own resources. Having made his decision, Edwin Knight started the work in early 2020, and by the end of the year he had finished the “Build” of a Sussex Dwarf [Figure 13] (see Appendix B for Edwin Knight's Notes about his ‘Build of a Lawson's Sussex Dwarf Safety Bicycle’) and he completed the job with a test ride captured in a video that can be viewed at <https://www.ichc.biz/2022-en/>

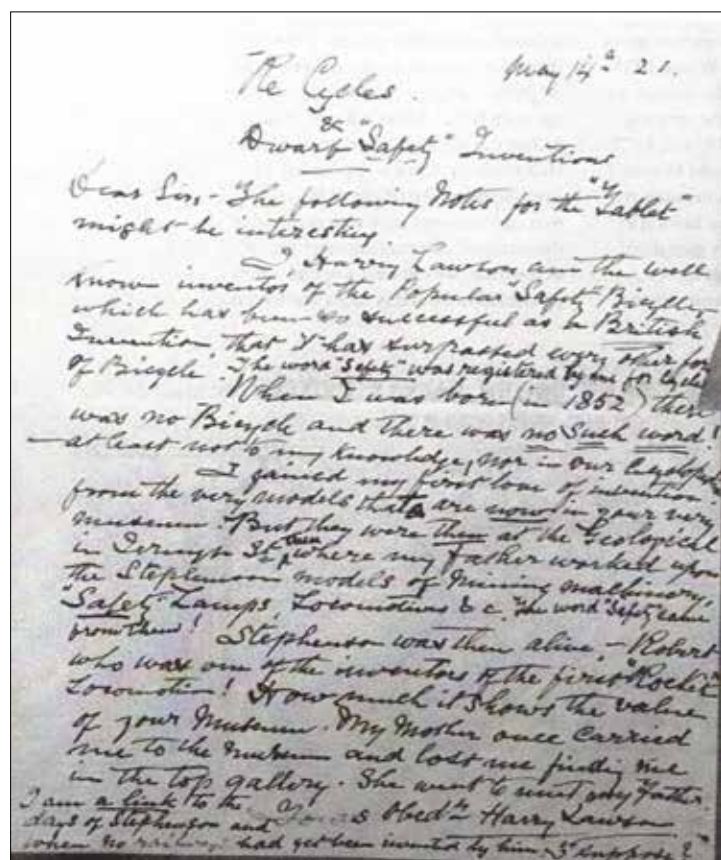


Figure 11. A note written by Harry J. Lawson when visiting the Science Museum in London, England with information about the Sussex Dwarf. This note has been stored in the Museum's vaults since it was written by Lawson in 1900.

videos/31-Sussex-Dwarf-ride-7.mp4. To confirm the finding that the Knight's Sussex Dwarf was "Road-Worthy", Knight brought this Safety Bicycle to the 2022 IVCA Rally in Oostende, Belgium, on May 26-29, 2022, where this bicycle was unloaded from his car and test ridden by about 12 different IVCA participants: All the test riders were competent, long time, bicycle riders, and they all independently professed that this "Build" by Edwin Knight of Lawson's Sussex Dwarf handled very well as a bicycle should do.

### THE AUTHOR'S CONCLUSION

I conclude that Mr. Harry J. Lawson's claim for having invented a true Safety Bicycle is true. This true Safety Bicycle was named "Sussex Dwarf" because of its small (23" diameter) wheels [Figure 3]. I summarize here the points described and discussed in the body of my paper to support my conclusion:

**A.** Harry J. Lawson was well trained as a practical engineer when he was 18-21 years old.<sup>1</sup>

**B.** Mr. Lawson professed to be the builder of a 'Safety Bicycle' called "Sussex Dwarf", and that he rode his newly built Sussex Dwarf Safety Bicycle around the City of Brighton during the time that he lived there in 1874-1875.

**C.** This claim was substantiated by Mr. John Keen, a reputable Champion Bicycle Racer, and a renowned builder of High Wheel Ordinary Bicycles. [Appendix A] Mr. Keen testified in a letter to the Editor of the Cyclist magazine of 1900 and printed on pages 30 and 31 of that publication that he traveled to Brighton in the spring of 1875 with several other notable bicycle riders of the time, and he met Mr. Harry J. Lawson who was at work building Safety Bicycles that had all the properties required of a "safety" bicycle.

**D.** In 1900 Harry J. Lawson at the request of Management of the Science Museum in London, England, while at the Museum prepared drawings of, and notes about, his invention.

**E.** Following the plans for Lawson's 1873/1874 Sussex Dwarf prepared by Harry J. Lawson in his own hand in 1900 at the request of the Management of the Science Museum in London, England, and preserved in the vaults of that institution, a perfectly working Safety Bicycle was

Mr. Harry Lawson Born 1852

Dwarf Machine made before the bicyclette is about 1873 or 4. it had wood wheels and was generally like the existing boneshaker. The chain was of lamina pattern.

The Green Machine of 1876 was made by ~~Rudge~~ Singer and a royalty of £2 per machine was paid.

The Bicyclette was made by Rudge and the reason for making the front wheel large was to enable them to change more fast. (to look something like a motor)

Sturmeys Article in Cycling 1919 mentions Lawson's dwarf machine.

"The Cyclist" 1879 gave a picture of the bicyclette

Lawson presumably patented a motor cycle in 1880 having made experiments in 1879.

Also motor cycle patent N° 24,791/1876 made by Humber

motor boat with Daimler engine 26 horse.

Information from Mr. Lawson of Charles Wood.

30/5/21

Figure 12. A note dated 05/14/1921 with information about the history of the use of Sussex Dwarf bicycles that was written by Harry J. Lawson for the Science Museum in London, England, and then stored in the vaults of the Museum.

built by Edwin Knight, a master builder of bicycles, and this bicycle has been tested and proven to be rideable and to perform as a bicycle should. [Appendix B]

### So, Why Was Lawson's Sussex Dwarf Not A Commercial Success When It Was Invented in 1873/1874?

Having thought about this subject, I have concluded that Lawson's Sussex Dwarf was not a commercial success because its wheels were so small at a time when High-Wheel Bicycles were dominant in the bicycling world, and they were much admired by all who saw them: High wheelers were "Spectacular and Captivating". Even the name given to the "Sussex Dwarf" was demeaning insofar as the word "Dwarf" suggested that this bicycle was "diminutive", "stunted", etc. The fact that Lawson went on to develop several "Safety Bicycles" [Figure 6] that were all characterized by having a large

wheel before or after the rider: La Bicyclette [Figure 7] is exemplary of Lawson's realization that the commercial success of any bicycle designed to have the qualities required of a "Safety Bicycle" had to also have a 'high wheel' to be accepted by the highly opinionated public. The similarity between Lawson's Sussex Dwarf [Figure 1] and his La Bicyclette [Figure 7] that was invented only a few years later is obvious with the one big difference being two small wheels on the Sussex Dwarf and the combination of one small and one large wheel on La Bicyclette which was Lawson's first (marginally) commercially successful Safety Bicycle. Unfortunately for Lawson, James Starley introduced his Rover bicycle to the public in 1879, and in the absence of the public knowing about Lawson's Sussex Dwarf from 1873/1874, Starley's Rover bicycle became widely accepted as the First Safety Bicycle in the World. ●

## Appendix A

*Testimonial from John Keen – Champion English Bicycle Racer, and Builder of Racing High Wheelers in the 1880s and 1890s<sup>11</sup> and an Acquaintance of Harry J. Lawson in Brighton: A Letter by John Keen dated 3 November 1900 published in “Cycling” (1900) on pages 30 and 31 from a Collection of Letters on the Invention of the Safety Bicycle published in this magazine.*

Seeing my name has been introduced into this lengthened Controversy, which appears to have undergone several bouts of doubt and suspicion since the matter was opened, just about a year ago, in the columns of a contemporary, the addition of my testimony before the close of the story may not come amiss. I remember very well indeed reading the Gloucester agent's account, which embodied the following statement: “There is not the slightest doubt of the genuineness of the machine I have purchased from the inventor, who not only invented, but built the machine himself.”

There is no reason why an inventor should not invent, and by the same rule, a builder might certainly be expected to build, but there is all the difference in the world between inventing and building, and building and not inventing, The Gloucester discovery was no doubt genuine enough, but behind the record, and, in my opinion, must suffer the loss of the claim made for it, without detracting from the bone fides of Mr. Wareing. Mr. G. Lacy Hillier has put before the cycling world my reply to his query relative to my experiences of the Bate's machines under my care at Lillie Bridge, West Brompton, where I was training in 1877. They were certainly very far from being “safety bicycles” and did not embody vital points which gave rise to the machines as we know them now. But apart from the foregoing, allow me to state that during 1876 and 1877 I was experimenting in the construction of safety bicycles and certainly made greater headway in those days than I have troubled to lay claim to. Indeed, early in 1877 I secured provisional protection for a machine, having in view improved steering and rear driving, when my works were in Clapham Junction, and remember very well that the wheels were only 24 in., that



*Figure 13. A picture of Edwin Knight on the Lawson's Sussex Dwarf Safety Bicycle that he 'built' from the plans drawn and annotated by Harry J. Lawson when he visited the Science Museum in London, England, in 1900 (See Figures 9 & 10 & Appendix A). This picture was taken by Ron Miller from Liverpool, Canada, at the 2022 IVCA Rallye in Oostende, Belgium in May 2022 where about 12 seasoned bicycle riders had a chance to ride this bicycle, and every one of these riders proclaimed that this Lawson's Sussex Dwarf Bicycle rode well and handled as a bicycle should.*

being the usual size. There were, however, difficulties which I found it somewhat hard to surmount. In the spring of 1875 the best amateur riders of the day, Taylerson, Osborne, Tyler, and others accompanied me to Brighton at the invitation of Mr. Rayward, a then well-known cyclist and resident of that popular seaside resort. He introduced me to Mr. H. J. Lawson, who was at that time busy making safety bicycles, and had helping him Mr. Biggs (still, I think, a resident of Brighton). Lawson was devoting special attention to the construction of a frame in such a manner as to allow the rider to stride the machine without taking the foot off the ground, and in this, in my opinion, he succeeded, making the machine, in every sense, a safety, and I for one fail to see why his claim to be the inventor was ever doubted. Rotary and lever motion were shown to me by him, and direct steering is simply the outcome of that applied to the old ordinary, which I lay claim to have been as much the first to introduce as any other man in the trade.

“My own idea of a safety, in 1876 and 1877, already referred to, was not sufficiently novel to undermine Lawson's foundation, which I ascertained he had started as far back as 1873; consequent-

ly, I dropped the matter, continued to manufacture ordinaries, and went on with my racing. Had it not been for Lawson, who gave us the “key”, the safety of the present day would have been unknown, and, as Mr. A. J. Wilson has stated, “We might have been riding the Ordinary to this day.”

## Appendix B

*Notes by Edwin Knight regarding issues encountered when doing his 'Build' of a Lawson's 1873/1874 Sussex Dwarf from the Drawings and Notes made of this Machine by Harry J. Lawson in 1900 at the Science Museum in London, England [Figures 9, 10, 11, 12].*

The story of the Lawson's Sussex Dwarf “Build” in 2021 by the ‘Builder’, Edwin Knight:

A couple of years ago, in 2020, I was asked if I would be interested in making an example of Lawson's first bike, by the author of the treatise on the subject, Mr. Nick Clayton (*The Boneshaker*, No. 214, p. 8-21, Winter 2021). At the time I was very busy, so my answer was negative.

Earlier this year, early 2022, Rob Damper was at the Kent Oldest Bike ride. He looked over my Rover No.1. I think

he liked what he saw. A short while later I received a paper from the VCC requesting me to tender for the build of the Sussex Dwarf. To include a video of how it was built using the Victorian methods of the time, being 1873. I was intrigued and felt that I could do it. I am lucky in that respect as I have a very good friend and excellent Blacksmith (Peter Trick) well versed in the use of Wrought Iron. Having been trained and employed for many years by the East London Bell foundry, up until it closed for business. Where upon he was given the full Blacksmith workshop and all the machinery and stock to help him continue with his chosen profession. The ideal person for me to collaborate with on the project.

I perused the papers for a while and realised it would result in a different bike from every person tendering. There was so little to go on. I also had grave reservations about the ability of the design not to fail or flex to a point of failure. Therefore, I thought the way forward would be to construct a proof-of-concept, i.e., to build a cheap construction using up to date methods and materials. I discussed the matter with Peter who agreed. This would test the plans and save on very expensive Victorian materials. I was intrigued enough to proceed with this at my own expense, with the aim of providing my findings with anyone who wished to see the outcome. Meantime, I contacted Peter who was prepared to draft up a Tender for the job. I have little interest in competitive tendering as I am a hobbyist. Luckily, he has a great stock of high grade wrought Iron to hand. Although it would need to be reformed into the right form by a rolling mill. To do it at his forge would be a very expensive time-consuming process by hand. He would wait until the proof of concept was available before proceeding having agreed that it was the only way forward.

I set about the construction. First using the only given dimension provided. Wheels were 23 inches diameter. Using the "Fag" packet sketches and the Museum's interpretation, I scaled up some measurements. My good friend John Gray drew up some wheels and provided the DXF files for the CNC router machine to make some plywood wheels and other steel parts. These would later be finished and coated in Epoxy Resin to give them a hard outer coating and help provide a strong wheel. The steel laser parts would need to be dressed and formed.

I noticed that the Coventry Museum afforded the opportunity to look at the next nearest machine to Lawson's Dwarf, i.e., the 1876 lever cycle. It was fitted with a very similar front fork design. Also, it provided a lot of design features across the frame in common with the primitive Lawson sketch. I tried to use the Lawson sketch as much as possible rather than the Science museum's interpretation to maintain primary information.

I subsequently set about constructing the frame, laser cutting the drive cogs, forks, front and rear. I used inch square mild steel bar then making it octagonal because it looked better. Retaining little areas of square for datum purposes. I decided to employ bronze bearings – akin to my Velocipede – The axle uses heavily chromed steel bar. The combination makes for a smooth easy rotation. The drive shaft uses cotter pins on the cranks and in the boss attached to the chain ring. Bronze bearings in the front drive. The cranks are very short, but this is of little consequence as the gear ratio is very low at about 36 inches. Unfortunately, the plywood sheet from which I cut the wheels had stood for a long while with side pressure from other stacked wood. This left a bow in the material; at £100 per sheet, it now has a wobbly pair of wheels on the bike. Then epoxy on the wheels to add a little strength which also glues the three elements of the wheel together along with some wooden pegs. I resized solid "Greentyre" tyres which drop into a groove around the circumference. The seat is bolted directly onto the top spring for simplicity. I made the handlebars fit at a greater height than implied by the drawing. I thought the riding attitude would be difficult with a lower reach. Plus, I have a bad back.

The steel elements were electric welded together. At this point I found the measurements and angles were a long way astray. The top spring would not fit. The wheels clashed with the pedals. I put this down to distortion in expanding the pictures and a lack of clarity from the sketch. There were further details around the primary sketch but without definition or only just in shot. A better copy with all of Lawson's information would have been excellent.

Material was added in various places: wheelbase, fork height and steering angles amended. The spring was reshaped until it fitted. The forward drive support horseshoe was cut off and better materials employed to stop the flex. Finally, the drive was fitted

by screwing the gear to the wheel boss and away we went on a successful machine. I subsequently replaced the half inch pitch modern chain with an inch pitch. I had a preference to use a Morgan chain, but I did not want to spend the time making it. There are some problems remaining. i.e., limited steering lock and clash of pedals with wheel. I had to invent the rear uprights fixture to the frame. Eventually I was able to assemble it and then try a ride.

I informed Bob Damper that the concept machine was rideable. Bob informed me that the V-CC had cancelled their participation in the project. Meantime: I was amazed at how well it rode. If such a machine had been built, it should have been a world beater. It easily outshone any vehicle I have ridden of the same time-period.

This led me to consider why it could have been abandoned. My conclusion is down to the type of chain available at the time to the 21-year-old Lawson. Having discussed the matter with other enthusiasts of the period we have concluded it would probably have been designed to use a primitive Morgan style chain. This type of chain may have had very little lateral stability resulting in it swaying about when used in the horizontal attitude such as the Dwarf needed. The subsequent derailment would have infuriated any rider. It could have been excessive flex in the front drive frame. I had to beef it up quite a lot with spring steel. Other than that, I leave you to come to your own conclusions.

*-Author: Edwin Knight (June 2022)*

1 Duncan, H.O. (1930); 'Story of the Bicycle'; The World on Wheels, Vol. 1, p. 293-312 (self-published).

2 "Stephenson's Rocket", Wikipedia, The Free Encyclopedia, en.wikipedia.org/wiki/stephenson%27s\_rocket. Accessed 07/02/2022.

3 Wignall, Christian (2017); The Cycle Share Boom and the Humber Company Promotions of the 1890s; Cycle History 28, p. 40-45.

4 Clayton, Nick (2019); Ernest Terrah Hooley – The Splendid Bankrupt; Cycle History 30, p. 62-64.

5 Duncan, 1930. Clayton, Nick (2019); Ernest Terrah Hooley – The Splendid Bankrupt; Cycle History 30, p. 62-64.

6 Duncan, 1930.

7 Roberts, Derek (1970); Truth, Myths, and Queries, 101 pages; published by V-CC.

8 Roberts, Derek (1990, 1991, 1993); The Invention of the Safety Bicycle – Correspondences in the weekly magazine CYCLING from 1 September 1900 to 15 December 1900; 1993 Edition, 52 pages; published by the V-CC.

9 Roberts, 1993.

10 Clayton, Nick (2020); The Sussex Dwarf – Harry J. Lawson's Safety Bicycle of 1873-1874; The Boneshaker, No. 214, p. 8-21.

11 Roberts, 1993.