held in the Central Library provided more information, much of the material Philip was able to find here and send over, was already in the States we found...the detective story was growing longer and longer.

In July 2005 Elizabeth spent five days with us. Her first degree is in Physics and Art...she doesn't send postcards home to her friends...she uses coloured pencils and crayons and sends drawings instead...she came with 42 addressed pieces of card and drew on the backs of them whatever took her fancy...ponies, moorland scenes, plants...her botanist friend got buddleia for example. She was very jealous of all the foxgloves growing wild in the hedgerows...she had been trying without success to grow some in her garden at home. Every time she had found a place name in her research she made a note of it so we visited and she photographed as many as possible of the places on her list.

In the Autumn of 2005 Elizabeth gave a paper on Jonathan Nash Hearder at a conference on the History of Science and Technology in Minneapolis. She has given me permission to repeat it here and now for you.

See page 65 for illustration

Blind Experimenting in a Sighted World: The Electrical Innovations of Jonathan Nash Hearder

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Experimental science is visually intensive: seeing things happen, positioning apparatus, reading meters. Is such work closed to the visually impaired?

Electricity sparks, but it also shocks, giving touch-sensitive feedback. In the eighteenth century, cataract-afflicted Anna Williams (1706-1783) was the first to draw sparks from an electrified human. In the nineteenth century, Jonathan Nash Hearder (1809-1876), a native of Plymouth UK, experimented without vision, developing multiple, informing perspectives on electricity.

Evidences of Hearder's life and experimental work are run through with contrasts. Hearder participated in the sighted world as an innovator and advocate for its science, while working personally with minimal or no vision. In public, he produced science demonstrations of visual spectacle, even on scales grander than anyone had seen before. Of his writing in print, allusions to his blindness are sparse and indirect. The public image Hearder constructed for himself was almost not to be distinguished from that of a sighted person. But at times, that appearance could shatter as tensions – fanned by Hearder's flair for controversy – spilled into open view with passion and acrimony.

But this strain between public presence and private blindness, was only a setting for the far more pervasive stream in Hearder's life: that of experimenting. Experimenting was how he encountered the world of nature, how he learned from it. And it was the experiment that he gave back to others, after extending it through his own labours and ingenuity. Experimenting welded together uncertainty and risk along with prospects of advancing science of practice. That raw and unsteady mix was where Hearder thrived most.

Explosive End to a Sighted Youth

Hearder's sighted youth was awash with visually stimulating surroundings: his dad's umbrella making shop; Plymouth harbour with its tidal rivers; and curiosities of public science. A lifelong absorption with sport fishing – its drama and tackle – got its start at the great seaport, and its efflux of rivers, many having their rise on Dartmoor's knobby heights. Growing up around tools, he became proficient making

things, working the lathe, understanding materials. Hearder first thrilled to the sights and grand ideas displayed by travelling science lecturers at local halls and Mechanics' Institutes, just then sprouting across Britain's industrial areas. There he joined "weekly meetings of the zealous...chemical class"[1], ardent to master these skills.

Soon the teenage Hearder was on the road himself, demonstrating his electric telegraph and other homemade apparatus in Plymouth, nearby Devonport, and further afield in Exeter and Newton Abbot.[2]

One lecturer at the Mechanics' Institute was a local natural philosopher William Snow Harris,[3] later knighted when the Royal Navy adopted his design for shipboard lightning conductors. From his Plymouth home, Snow Harris investigated static phenomena of electricity and magnetism, working largely uninformed about electric current with its chemical, magnetic and other dynamic properties. The aspiring young electrician, Hearder, made Snow Harris' acquaintance, assisting in research,[4] constructing apparatus, and defending Harris' lightning conductors in the local press. These early experiences with the electrostatics of a previous generation's science, underlay the induction inventions of Hearder's mature life, and his side-business in lightning rod installation which passed on to son William. More than that, the tangible feedback of electrostatic shock served him as means for experimenting after his vision loss.

Hearder's departure from the sighted world was the sudden outcome of a chemical experiment gone awry. Soon after the accident, he wrote about it for the literary journal he coedited with brother George. He was preparing highly explosive and shock sensitive fulminating silver.[5] Chatting with a friend, he inadvertently let the stir rod touch the precipitate while working at eye level. The rod's shock set off the explosion, shooting glass and acid into his face. Immediate resort to a water bath, weeks of leeches and other interventions, recovered no more vision than what he described as the ability "to distinguish [light] from darkness, or to perceive...a window in a room".[6]

Hearder was not alone in falling victim to fulminating silver. The same calamity befell two contemporary American chemists. University of Pennsylvania's Robert Hare suffered fractures and lacerations to the hand, and eye, while pouring the powder, whose impact triggered the explosion.[7] Yale's Benjamin Silliman peered into a flask while stirring. He erroneously assumed the liquid form was non explosive.[8] Silliman's ordeal mirrors Hearder's: acid in the eye, acute pain, blindness, treatment by leeches. Silliman's vision was restored. Hearder's was not; perhaps he regained minimal vision; one photograph shows him with thick glasses.

The accident did nothing to diminish Header's ardour for experimenting. His youthful account of it advocates the useful knowledge to be gained by "trying

experiments", like Silliman, he ascribes the accident to improvidence with the stir rod. Experimenting with electricity, inventing, working with materials and communicating science remained lifelong undertakings for Hearder, as documented in his published papers, notices about lectures, and trade brochures.

For the sightless Hearder, the challenges of sustaining an experimental relation with nature differed from those of negotiating the human world. It is in interacting with others, that records of Hearder's life hint at troubles. The accident had as much an immediate effect on his human circumstances, as on his visual acuity. The twenty-two year old supported himself through a "Classical and Scientific Academy", where he was the first to teach science in a Plymouth school. After losing his sight, Hearder announced school would continue "...as before his accident, having engaged a competent ASSISTANT to superintend...such branches [of learning] as require the more immediate use of sight..."[9] However, as an associate later remarked "prejudicially...people thought sight absolutely essential to teaching".[10] Hearder's school soon disbanded.

Next Hearder took up music, an early interest presumably more suited to his condition. His name appeared as a teacher of accordion and pianoforte, promising unique pedagogy, as well as a tuner and salesman.[11] Professional music proved too competitive although music remained an avocation. On his father's death, Hearder assumed the family business. In the forthcoming decades, he transformed the umbrella manufactory into Plymouth's foremost supplier of deep-sea and freshwater fishing tackle – even supplying the HMS Challenger mission. *(Dr Gerald Boalch of the Marine Biological Association who is researching the history of fishing believes that JNH is the inventor of the Otter Trawl still used by fishermen and, until the mid twentieth century, in a modified form by Royal Naval minesweepers).*

Hearder carried a full line of sporting goods, home heating stoves of his own design, and electromagnetic apparatus.

Medical Coils

For the sightless Hearder, electricity's behaviour was accessible though the sensation of shock. As the fulminating silver episodes suggest, nineteenth century experimenting brought the researcher's body into proximity with whatever was being investigated. With electricity, the body was often part of the circuit. Experimenters routinely took the shock to know what was going on. This research practice evolved into therapies for sufferers of paralysis, and other ailments. Shocking coils became available for home use in the 1840s. Professional medicine looked down on these treatments, declaiming the quackery of "self-styled medical galvanists".[12]

Into this climate where electricity, the body, and medicine connected in stimulating ways having uncertain outcomes and much public appeal, came Jonathan Hearder's engagement with shocks, coils, and medicine. Beginning in the 1840s, Hearder later rose to such status in medical galvanism as to decry its "indiscriminate abuse" by those unqualified.[13] He invented and improved shocking devices, marketed them, and treated thousands of patients. His "graduated medical galvanic coil", honoured with the Royal Cornwall Polytechnic Institution's silver medal was demonstrated at the British Medical Association's Plymouth meeting (1856)[14] and described favourably by physicians such as Pereira's 1854 text on *Materia Medica*.[15] The South Devon and East Cornwall Hospital first recorded Hearder as its Medical Galvanist in 1871, where he claimed to hold the role of "consulting electrician" from 1845 onward. His electrical treatments were better than the leeches!

Hearder's *Treatise on Medical Galvanism* described his coil's use and therapies, alongside laudatory testimonials by local and London physicians as well as ordinary folk like a laundress and a piano tuner.[16] The self-promoting tone, little mitigated by being set in the third person, leaves no doubt as to the professed advantages of his invention's compactness, means of regulating shocks, and efficacy in healing all disorders from toothache to paralysis. While the treatise nowhere mentions Hearder's visual limitations, "dimness of sight" and "amorosis or progressive paralysis of the optic nerve" are discussed in these promising words:
"Dr. Hearder's experience goes to show that not only may incipient amorosis be checked, but the further progress stayed, even after the disease has considerably advanced".(p40) Was "Dr. Hearder's experience" personal – a veiled allusion to efforts to heal himself, to "check" deterioration and wishfully restore lost vision? Given his abiding faith in the advances of experiment, it is easy to imagine him trying self-administered shocks.

Hearder's science was more deeply expressed in the homemade instruments, materials, and their electrical actions, than in the words that come down to us. What was this miracle coil of wire, iron and paper? The two medical coils we'll see in my photos are the only complete JNHearder instruments that I know about; all Hearder instruments preserved at the Plymouth Athenæum were destroyed in the bombing of April 21, 1941. I thank family member Ian Hearder for the opportunity to examine an original medical coil, from nearly a century and a half ago. ***(In fact Elizabeth saw when she was here the one incomplete coil we still have and his clock which chimes every five minutes.)***

Inside the almost cubical carrying box with its ivory nameplate, are divided compartments for coil, battery jar, acid jar and shocking handles. By unscrewing the coil from the box's base, it can be lifted entirely out. All connectors, controls, and action were mounted on the coil's mahogany top lid. The contact breaker's screw touches the top of the hammer spring to complete the circuit of current going from the battery and into the thick primary wire. Here in a top view of just the lid, the

contact breaker screw mounted over the spring's iron-headed hammer, which would vibrate to and fro from the coil's iron core masked by the mahogany disc in the middle. On the top, the buttons number (top) 0 to ¾ and (bottom) 1 to 6, each with a variable position selector. Hearder touted his invention of this index for offering "graduated shocks" stepped in strength from 1, through quarter steps and whole steps, to 6. Hearder never explains how this is accomplished in the concealed wiring – was he keeping it a trade secret? Pereira's medical text claims that Hearder's index varies the length of secondary wire included for the shock, from a minimum of 80 feet, to a maximum of 320 feet (Pereira, p 56). I was unable to check this, a voltmeter registered only an open circuit across any of the buttons or wires.

In this side view the coil is upright from the lid. The hollow wood bobbin contains the iron core, and is surrounded first by a three-layer winding of thick copper wire – which itself is insulated by wound cotton thread. A thick grey paper, like the coil's outer cover, intervenes between these turns of thick wire, and the secondary winding of thin iron wire. Exposed bits of thin iron wire are bare – leaving me to wonder if it is bare in its entirety. Did Hearder space wire in laying it on, keeping one turn from contacting the next? I've learned from my own coil making this is a technique of feel, tactile and non visual. This cross-section view shows the windings edge-on. Newspaper print shows at the edges where it separates the 4 layers. The coil innards' want of finesse recalls a contemporary appraisal of Hearder's instruments, calling them: "somewhat rudely constructed by the blind experimenter, [yet] of great ingenuity".[17]

The Hearder medical coil in the Minneapolis Bakken Museum is a later production model, similar in design, with better finish, knobbier controls, recessed core.[18] The coil is fitted with a block making it impossible to examine its layers edge-on. With improved craft, came reduced access to its interior. Was this to prevent customers from spying on, or damaging, the works?

One of Hearder's medical coils was displayed with the forty-year old's modest entry at London's Great Exhibition of 1851, beside a 71 pound cast iron horseshoe permanent magnet. Perhaps that one predated both the coils we've seen here, as the programme made no greater claims than that the primary wire matches the battery.[19] Soon Hearder came out with a "Condensed General and Obstetic Electromagnetic Machine", which was adapted for London hospitals and favourably reviewed.[20]

Induction Coil: Insulation, Experiments, Controversy

Five years after the Great Exhibition, Hearder emerged to wider scientific and popular attention with a display fiery both in its electricity, and its contentiousness. On three dates in February 1857, he demonstrated a new induction coil to "crowded [London] audiences"[21] who gathered in increasing numbers, excited and astonished by the experimenter's blindness.

Speaking about the coil's experimental development, he said: "I have often been struck with the exalted statical condition of...my largest [medical coils], although no attempts at insulation beyond the ordinary cotton covering of the wire were made, and often promised myself to try the effect of a more perfect insulation..."[22]
Was this observation literal? Had medical coil shocks felt to his hands like electrostatic shocks from friction machines, such as those he built for research with Snow Harris? Hearder isn't more explicit, saying only his old medical coils gave "vivid sparks" and other high tension effects.[23]

This realization, that medical coils put out electricity at much higher *tension* than what went into them from the battery, was key to Hearder's innovation. His induction coil was a medical coil with better insulation, better than that of such contemporaries as the renowned Ruhmkorff. Improved insulation was crucial in containing the high induced tensions to the wires and preventing damaging discharges within. Hearder's mile-long thin wire was wrapped in silk along its length. Between layers of its windings were insulating sheets. In print, he said these sheets were gutta percha, a newly introduced latex of which Hearder was an early advocate – but in his London lecture, he admitted to also using oiled silk – an umbrella fabric. Header asserted his superior insulation by lambasting Ruhmkorff's "defective" paper-separated layers. I think it's fascinating that artefacts preserved for us show Hearder continued using newspaper – and likely bare fine wire – in medical coils for decades to come. Hearder's medical coil stayed a fixed commercial product, while his inventiveness redirected to high tension devices and fishing tackle.

Header's London show was a spectacle of sparks. Sighted audiences were treated to noisy sparks, while the blind experimenter worked by touch and sound. A reporter wrote: "if he had not at the commencement made known his loss of sight, no one would have discovered it."[24] "Thick crepitating sparks" traversed a four inch gap between electrodes. By separating the electrodes further, the space between darkened while the ends glowed with "brushes of light" and a "characteristic star". Putting alcohol lamps in the gap extended the spark's range a foot. Sparks ignited acid-soaked wood, also paper, cotton, gunpowder! Metal filings, sprinkled on glass and shellacked in place, gave rise to spark paths of the metal's characteristic spectral colour.

Next, Hearder adapted demonstrations traditionally done with electrostatic machines, for the coil. As a new source of high tension electricity, the coil was distinguished by unremittant discharges. For example, connecting a Leyden jar across the coil gave a "roar of discharges". On putting the coil across a long festooned iron chain "scintillating" light shone at every link. In Cavendish's day, a discharge lit a chain only momentarily; but with the coil running, light persisted.

But how fast was the coil's discharge rate? Hearder needed to know, to construct the "precisely similar" conditions he sought for comparing the coil's electricity with that of electrostatic machines. On a hint from (Sir) William Grove, Hearder put paper in his coil's gap to perforate it by sparks. To establish a constant time interval framing these perforations, Hearder constructed a second pendulum such that wires from the coil's terminals swung with it. The entire spark gap oscillated with a one second period. Paper within the gap was perforated during each swing and repositioned between. These perforations recorded the coil's discharges tangibly. With his hands, he could read an audible tone of 100 to 200 cycles per second.[25]

Performing in London brought Hearder into public notice with a response that was only in part scientific. At the Society of Arts, William Grove and prominent telegraph engineers Highton and Cromwell Varley questioned Hearder about coil dimensions, makeup and power. Comparing it to a dissected Ruhmkorff coil, they analysed these coil's workings. Their tone was deliberate, informed, critical, making no mention of Hearder's blindness. A very different tone emerged in the *Mechanic's Magazine*, which later erupted into the *Philosophical Magazine* alongside Hearder's scientific papers. Rival coil makers were increasingly acrimonious in challenging Hearder's priority, claims about his coil's power, and the fairness of comparison tests that invariably put Hearder's coils to advantage.

Defending Hearder, the *Mechanic's Magazine* departed from technical issues saying:

"With regard to the mode of conducting the experiments, we have all confidence in it. Mr Hearder is an old and experienced practical electrician...a remarkable instance of indomitable perseverance. It may not be generally known that Mr Hearder was deprived of his sight...a circumstance which...would have disheartened many others, only seems to have excited him to redoubled efforts in...science..."[26]
This assessment reframed the virulent priority debate under a special status: who could question such dedication in the face of unfathomable adversity? The implication that no one could wish harm on someone so disabled, masked the editor's patronising revelation of Hearder's blindness.[27]

Blindness: Status and Stigma

Where Hearder's blindness sometimes elevated him to a special status, in other settings it was used against him. He suffered from the stigma of what blindness meant to others, more than from the direct disability.[28] Among London audiences, by disclosing his disability at the same time as he foiled people's expectations of it, Hearder aroused awe, curiosity, pity – and a sense of science as a higher mission overcoming all odds. The uglier side reared some months after the London presentations. Hearder and the Plymouth Mechanics' Institute came to loggerheads over programme content and funds. In a shouting match, the Mechanics' chair called Hearder a "coward, fool, liar and dishonest man" and it was said that "Mr Hearder, whose voice...as on most occasions was more than a match for those opposed to it, united."[29] Hearder sought vindication in the press, alleging the chair "was shielded by my misfortune, otherwise he would not have dared" say such things,[30] while others stood silent "incognito as far as I was concerned", letting abuse go on.[31] The newspaper, like the *Mechanic's Magazine*, championed Hearder for bringing "a little light in on the [chair's] proceedings.[32]

As a scientist, educator, science popularist, successful in business, medicine, and fishery, Hearder sought to be a trusted authority. To gain people's trust, whether for selling "Hearder's Celebrated Prize Silver Spinner"[33] or treating nervous disorders, or proposing improvements to the maligned Atlantic Cable, Hearder often found it advantageous to conceal his disability. Blindness fragmented from his public image, his accomplishments and legacy. As a result, Hearder's story and experimenting with non-visual evidence was cut off from communities who might benefit. And the stigma perpetuates as unquestioned myths that people like Hearder cannot do experimental science.

That such myths are groundless is illustrated by another Hearder undertaking: a stupendous project which first brought light to Plymouth's night time harbour. Atop historic Devonport Column, he built an electric spotlight backed by a parabolic mirror, powered by a gigantic cast-iron battery. As a public event – with military backing – he panned its intense beam across landmarks, out to 16 mile distant Eddystone Light.[34] Sharper than day were ivy leaves, grass blades, ship's rigging at sea, prayer book print. Children made "Rabbits with their fingers" on a nearby wall [35]. Reports came in from everywhere: that night was not the same – through the experimenting of one who knew how to see, as he once wrote, "I see with fifty pairs of eyes...You...only see with one pair of eyes...[36]

Acknowledgments

Ian Hearder, Margaret Hearder and family, Philip and Betty Smith, Vivian (Hearder) Parsons, Patricia Luxford, Ellen Kuffeld, Elizabeth Ihrig, Bakken Museum and Library, Dibner Institute for the History of Science and Technology, Burndy Library, Plymouth Athenæum, David Pantalony, Roger Sherman, Alva Couch, Philip Morrison.

The 36 references which follow this paper are appended.

Elizabeth was allocated 30 minutes in which to deliver her paper...she admits that she had to rush it but she was talking to fellow scientists. I have taken it at what I consider to be a normal speed. I've read it several times now and I think I now know what she it talking about, I hope you do too!

Notes:

1 J.N. Hearder. "The Mechanics' Institute, *Plymouth and Devonport Weekly Journal*, December 10, 1857.

2 W. Harpley, "Obituary Notices, "Jonathan N. Hearder". *Report and Transactions of Devonshire Association for the Advancement of Science, Literature and Arts*, IX, 1877, p.55-60.

3 "Mechanics' Institute" *Plymouth Herald and Devonshire Freeholder*, April 8, 1826.

4 William Snow Harris, "On a New Electrometer, and the Heat excited in Metallic Bodies by Voltaic Electricity", *Royal Society of Edinburgh Transactions*, 12, 1832, p.206-221, see p.213.

5 Fulminating silver's dangers are discussed in *The Young man's book of amusement: containing the most interesting and instructive experiments*, Halifax : Milner and Sowerby, 1854.

6 J.N. Hearder, "A Few Remarks on the Value of Chemistry together with an account of an accident which deprived him of sight", *South Devon Monthly Museum*, 1833, p.113-117.

7 B. Silliman. "Injury sustained by Dr. Hare...fulminating silver...", *American Journal of Science*, 22, 1832, p.185-7. Edgar Fahs Smith. *The life of Robert Hare, an American Chemist (1781-1858)*, Philadelphia, J.B. Lippincott company, 1917, p.205-6.

8 Benjamin Silliman, "Accidental explosion of Fulminating Silver..."*American Mineralogical Journal*, 1, 1814, p.163-166; John Fulton and Elizabeth Thomson, *Benjamin Silliman: 1779-1864 Pathfinder in American Science, Henry Schuman NY 1947, p. 84-86; Chandos Brown, Benjamin Silliman. A Life in the Young Republic*, Princeton University Press NJ 1984, p.261-2.

9 Advertisements for Hearder's school appeared in *Plymouth, Devon and Stonehouse Herald*, January 15, 1831, July 16, 1831; January 6, 1832; The reopened school was announced in the *Herald*, January 5, 1833.

10 W. Harpley, (1877) Jonathan N. Hearder. *Report and Transactions of the Devonshire Association for the Advancement of Science, Literature and Arts, IX*, p.55-60.

11 *Plymouth and Devonport Weekly News*, January 8, 1838. Nearly two decades later, his name was listed as the Natural Philosophy instructor of Rev. Barter's Boarding and Day school, noticed in the issue of January 31, 1856.

12 G. Bird, (1846). On the Employment of Electro-Magnetic Currents in the Treatment of Paralysis. *Lancet*, p.649-651, quote p.649.

13 Jonathan Hearder, *A Treatise on Medical Galvanism*, Plymouth, 1871? p.5. This work exists in a unique copy, generously made available for study by Margaret Hearder and family.

14 "Improved Medical Induction Coils", *Mechanics' Magazine*, Saturday Aug 15, 1857, p.154.

15 Jonathan Pereira, *The Elements of Material Medica and Therapeutics*, Longman, London 1854, p.57.

16 I thank Patricia Luxford, Heritage Officer of Ford Park Cemetery Trust, Plymouth, UK for identifying 8 of Hearder's testimonial writers in the 1881 census.

17 (1877). *Journal of the Chemical Society*, 31, p.500-501.

18 This coil is nearly identical to another coil in Ian Hearder's collection, having a paper insert printed with the name of Hearder's son, William Hearder.

19 *Official Descriptive and Illustrated Catalogue*, volume 1, London, W. Clowes and Sons, 1851 p.461. *Reports by the Juries on the subjects in the thirty classes into which the exhibition was divided*. London, W. Clowes & Sons, 1852, p.280.

20 "Mr Hearder's Condensed General and Obstetic Electro-magnetic Machine", *Lancet*, 1, 1854, p.670.

21 Hearder's Lectures on the Induction Coil, *Mechanics' Magazine*, Saturday Mar. 21, 1857, p.266.

22 J.N. Hearder, (1856-7). "On some new statical and thermal effects of the induction coil." *Annual Reports and Transactions of the Plymouth Institution and Devon and Cornwall Natural History Society*, 1, Isaiah Keys, Plymouth, 1865, p.1-14.

23 J.N. Hearder, (1857) Abstract of paper on a new Induction Coil. *The Engineer*, Feb. 20, 1857, p.144.

24 Hearder's Lectures on the Induction Coil, *Mechanics' Magazine*, Saturday Mar. 21, 1857, p.268.

25 J.N. Hearder, (1857). "On some new statical and thermal effects of the Induction Coil, with a new instrument for registering a rapid succession of electrical discharges, and a comparison of the effects of the induction coil with those of frictional and hydro-electric machines". Read at Plymouth Institution Nov. 27 and Dec. 4, 1856, and at the London Institution, Feb. 16 and 23, 1857, p.1-14.

26 "Hearder's Induction Coil", *Mechanics' Magazine*, Saturday Jan. 10, 1857, p.38.

27 Catherine J. Kudlick, "Disability History: Why We Need Another 'Other'", *The American Historical Review*, June 2003
<http:/www.historycooperative.org/journals/ahr.108.3/kudlick.html> (29 Sep 2005) par. 8.

28 Ibid. par. 33. See also Erving Goffman, *Stigma, Notes on the Management of Spoiled Identity*,
Englewood Cliffs NH: Prentice-Hall, Inc. 1963

29 *Plymouth and Devonport Weekly Journal*, Dec. 17, 1857.

30 *Plymouth and Devonport Weekly Journal*, Dec. 17, 1857.

31 *Plymouth and Devonport Weekly Journal*, Dec. 31, 1857.

32 *Plymouth and Devonport Weekly Journal*, Dec. 17, 1857.

33 J.N. Hearder, (1873). Guide to Sea Fishing and the Rivers of South Devon and Descriptive Catalogue of his Prize River and Sea Fishing Tackle, Cricket, Archer, Croquet, Umbrellas, Parasols, &c. with Edible Fish "In Season" (6th edition; also 5th). 195 Union Street, Plymouth, p.29.

34 J.N. Hearder, "An Account of some experiments made with the Electric Light", *Report and Transactions of the Devonshire Association for the Advancement of Science, Literature and Arts*. I part 4, 1865, p.78.

35 William Walker to J.N. Hearder, April 13, 1849, *Plymouth, Devonport and Stonehouse Herald*, April 21, 1849.

36 W. Harpley, (1877). J.N. Hearder, Obituary Notices. "Jonathan N. Hearder" *Report and Transactions of the Devonshire Association for the Advancement of Science, Literature and Arts, IX*, 1877, p.55.

Mrs B.J. Smith

WOMEN IN A MAN'S WORLD

I want us to spend some time looking at the role of women in a man's world...pioneering women, if you like. Women like Cleopatra and Boudica, (or Boadicea if you prefer) for example. There will, of course, be those whom you think should be included who are not and those whom I have included with whom you disagree! Examples crop up in the most unexpected places! For example in a recent woman's weekly magazine there was an article entitled "One woman in a man's world" and it was about a woman who, in 1978, became the first woman guard on a train. At 19 she was a switchboard operator working for British Rail at Waterloo. The husband of one of her colleagues had a new job as a guard with pay double that of the women. Everyone grumbled that men got all the best jobs, then they remembered that the new law meant that women could get them too and they decided to put the theory to the test. Helena Wojtczak was the youngest in the office and, pushed by her colleagues, she applied. At her interview she was told that the railway did not employ female guards but that the new law meant that they must allow her to take the course...she was now determined to get the job! Her fellow "learner guards" were hostile, taunting her with remarks like "women had no business with trains except to clean them". Instead of the regular guard's uniform with its two silver stripes on the sleeves and a peaked cap she was presented with a female carriage cleaner's uniform so no one recognised her as a guard until one of her colleagues gave her a peaked cap, and another a jacket with all the necessary pockets...and the stripes! Life was difficult...she didn't fit in with the women because she was a guard...a male grade... and she didn't fit in with the men simply because she was a woman and she squirmed at their crude banter. After nine years she moved from London to Ramsgate and there realised how progressive her London colleagues had been. Now she met hidebound prejudice and provincial narrow-mindedness. Despite her nine years of experience she had to PROVE herself. In 1992 she moved to Hastings where there were women guards and train drivers who took no nonsense from the men, so she was much happier there. Two years later she became consultant historian to the National Railway Museum, graduated as B.Sc. and three years later was awarded Honours. Unfortunately, soon after that she had an accident. She slipped on some diesel and damaged her spine so now she is earning her living by writing about her experiences. The Paignton and Dartmouth Steam Railway has a coach named Helena in her honour.

If you see the Western Morning News you may have read about Bertha Winchester who was Britain's only woman gravedigger. Her father was a gravedigger in Totnes cemetery for 30 years and when Bertha was 15 she began to help him. They lived in Cemetery Lodge which was a tied cottage, so when he died she was officially