Seeds without Patents: Science and Morality in British Plant Breeding in the Long Nineteenth Century.[1]

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1. Introduction

Literally and figuratively, plant breeding in Britain during the long nineteenth century was a growth industry. Over this period a huge number of new plant varieties came onto the market. Yet no legal framework for protecting new varieties existed in British plant breeding. Even when it did emerge, with UPOV in the 1960s, the rights introduced were not strictly patents. In British plant breeding, then, we have an apparent counter-example to the thesis, advanced by Dutton [1984], North [1981], Kahn [2005] and others, that patents are necessary–and effective–incentives to innovation. This thesis has already been challenged in a general way by Boldrin and Levine [2008], who have demonstrated empirically that an inability to patent need not have been, and still need not be, a disincentive to innovators. What is more, MacLeod [1991], Allen [1983] and Nuvolari [2004] have shown that even in patentable areas of innovation some innovators elected to avoid the use of patents.

In the light of this revisionism, the question to pose about nineteenth-century British plant breeding can be put with greater precision. Given high levels of innovation without patents, what non-patent means were used to exploit innovations? Clues to an answer can be found in the works in innovation studies and economic history cited above. It seems innovators typically selected from a range of possibilities for protection, including attribution rights, trademarks, secrecy and collaboration. This literature has also indicated that the choices made, and their implementation, were guided partly by the type of

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innovation being exploited and partly by the specific institutional environments in which innovators operated. Drawing inspiration from these new studies of patent-free innovation, this paper offers a survey of the protection strategies current among British plant breeders in the long nineteenth century (which here extends into the 1920s).

We start in (2) with an exploration of how nineteenth-century breeders' reputations helped make plant breeding pay, despite a number of challenges. In (3) we turn to the state of debate as to the role of science in aiding breeders to overcome the challenges of plant breeding. In (4) I go on to outline a new analysis, suggesting that science was important to breeders in a sphere I will call the moral economy of plant breeding. The three case studies presented in sections (5) to (7) illuminate aspects of the operation of this moral economy and the role played within it by science. My aim is to show that placing these stories side by side reveals two interesting and previously unrecognised features of the history of plant breeding in this innovative yet patent-free place and period. The first is the forcibly collaborative nature of nineteenth-century British plant breeding. Whether they liked it or not, British plant breeders understood that they were bound together by the self-reproducing nature of the plants they worked with. This situation stands in stark contrast to later developments. The second is an unexpected continuity across the so called 'Mendelian revolution'. Despite the claims of Mendelian plant breeders to have made a fundamental break with previous methods they were still deeply ensnared in the moral economy of plant breeding, in which reputations had to be carefully built, and the idea of scientific breeding was not new.

2. How reputation helped overcome some of the problems of nineteenth-century plant breeding.

British plant breeders of the period faced a range of problems. The first, and perhaps biggest, was that seeds were sold on trust; they needed to be grown for their merits to be assessed. As such they were sold not so much on the appearance of the seeds themselves but on the promise of the plant they might become, a promise that was often based on a breeder's reputation for delivering quality seeds. It is unsurprising, then, that seed firms

were at the forefront of the development of persuasive advertising.[1] Their lavish catalogues showed illustrations of the plants that one could expect from the seed being offered and details of yield performance underwritten by accolades accrued by previous varieties.[2] Advertisements were taken out in the horticultural press, especially in the market-leading *Gardeners' Chronicle*, an extraordinarily popular weekly imprint with a circulation rivalling those of the *Economist* and the *Guardian*.

Three societies provided space for breeders trying to show their varieties were better than anyone else's. The Royal Agricultural Society of England and Wales (RAS) sold advertising space in the pages of its journal and at its yearly shows breeders could compete for a small number of prizes awarded to the best varieties of farm crops.[3] The largest giver of prizes was, however, the Royal Horticultural Society (RHS). At this society's yearly shows, certificates were bestowed upon new varieties, ranging from first class to botanical commendation.[4] Breeders were also allowed to offer their own prizes at the RHS's shows for particularly fine specimens of their latest offerings. Like the RAS, the RHS also published its own journal. Finally there was the British Association for the Advancement of Science. The association's meetings, and in particular those of its botany and agricultural sections often played host to scientifically minded plant breeders and members of the RAS and RHS. While these meetings were not the correct place for overt reputation preening or commercial overtures, association with the Association was good for a plant breeder's reputation.[5]

The problems seed firms faced didn't end once they had persuaded a grower to purchase their seed rather than anyone else's. With most plants, propagation from a first to a second generation was a simple matter, one that growers could undertake for themselves. So, having purchased a batch of seeds, they had little reason to return for

[1] On the shift from informative to persuasive advertising and the rise of experience products see Church [2000]. See Kevles and Bugos [1992], Kevles [2007] and Moskowitz [2008] on plant breeders and their catalogues in the US.
[2] Significant collections of catalogues are held at the National Institute of Agricultural Botany, the Museum of English Rural Life and the RHS's Lindley Library.
[3] See the paper from Brunt in this volume on prizes at the RAS and Moser [2004] on innovation and prizes more generally.
[4] On the history of the RHS see Elliott [2004] and Olby [2000]. On botanical societies and interactions between plant breeding, science and culture in America see Pauly [2009].
[5] On credit and intellectual property in science see Biagioli and Gallison [2002].

another. This problem was particularly felt in the agricultural side of the seed business. On one historical analysis, at mid-century the majority of the country's wheat was grown from seed saved back by farmers from the previous year ([Brassely 2000]). Once again, reputation, as evidenced in trade catalogues, the press, and society prizes and publicity was used to try and persuade farmers and other growers that they would be better off buying a new stock of seeds, rather than producing their own. In some cases this was achieved through the production of ever more novelties, in others, through claims that fresh seed was needed each year to retain purity or vigour.

Breeders faced yet another problem in the form of competition with their rivals. Having lavished great efforts on persuading customers that one's seed was as good as one's reputation, a breeder could do nothing to stop competitors using this superior seed as the raw material for their own breeding programs, secrecy was mostly not an option. Indeed, many breeders produced what were known as 'synonyms'; varieties taken from another breeder and renamed without any additional breeding at all. The other side of this problem, sometimes referred to as antonymy, was the application of an established variety's name to inferior seed. In the world of nineteenth-century plant breeding nobody could cut out anyone else from using their products to perform more breeding, or, if they were unscrupulous, to simply steal a new variety. Breeders had very little protection against such practices. However, some firms sought to restrict their seeds to direct sales, in sacks marked with seals, thereby protecting their hard won reputations to some degree. In the catalogues, shows and societies where breeders sought to establish their reputations science was widely discussed.[1]

3. The role of science: the capitalisation and professionalisation theses.

[1] For instance, the RAS's motto, coined in the 1830s was 'Practice with Science.' On the importance of biological science to agriculture in nineteenth-century America see Olmstead and Rhodes [2009].

On a standard historical view of plant breeding, advances in scientific knowledge of plants were translated easily into progressively better plant varieties.[1] Countering this view, and writing from within a Marxian perspective, agricultural economist Jean-Pierre Berlan has argued that scientific breeding methods were used instead to protect the intellectual property in plant varieties. He claims that in the years before the introduction of UPOV rights, "doing this legally was *politically* unthinkable", (Berlan [2000], p.511, emphasis in the original).

With little hope of legislative change which would bring plants into the realm of patentable products, breeders, according to Berlan, turned to science to help them protect their varieties from piracy and recoup capital spent on breeding. What is more, these interventions produced increases in yield no greater than non-protective methods might have. Berlan's main case studies are the use of hybrid maize from the 1930s and the development of terminator genes from the 1980s.[2] Hybrid maize varieties produced poor seeds, thus discouraging farmers from saving any for planting in the following year and inducing them to buy new stocks. At the same time, this feature of the new varieties blocked competitors from using the seed for breeding. Terminator genes achieved the same ends, by stopping the plants into which they have been transferred from reproducing. In both cases, as Berlan sees it, biological science allowed the penetration of capital into a market which had traditionally been poorly capitalised.[3]

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[1] For what might be called the progressive history of plant breeding see Lupton [1987], Murphy [2007] and Kingsbury [2009]. See also more cautious classics from Zirkle [1935] and Roberts [1929].

[2] Berlan [2000] uses the term 'hybrid corn', although as he makes plain, this common denomination for a range of products and techniques is itself a misnomer; most corn, being cross-fertilised naturally, is hybrid. I use the term 'hybrid maize' (following Berlan and Lewontin in other articles) to refer to the line of new varieties, initially derived from work by Shull, then developed by East and Jones and later commercially exploited by companies such as DuPont, including F1 hybrids, because in English the word corn is misleading, meaning 'maize' in American English but 'grain,' including wheat, in UK English.

[3] On the capitalisation thesis see a series of articles from Lewontin, Levin and Berlan in the *Monthly Review,* referenced in Singh [2001]. Jack Kloppenberg's [1988] classic, *First the Seed*, is perhaps the fullest explication of this line of thought, for an overview of the two key book length treatments of hybrid maize see Palladino's comparative review [1991] of Kloppenberg [1988] and Fitzgerald [1990]. For further developments in Britain see Rangnekar [2000].

Let us call Berlan's argument the 'capitalisation thesis.' A related but distinct argument, amounts to a 'professionalisation thesis.' Its author, in Britain, historian of science Paolo Palladino, has argued that the Mendelian theory that spread from 1900 provided an esoteric body of knowledge around which academic plant breeders and geneticists were able to professionalise.[1] With professionalization came academic security and a platform from which to argue for public funding. On Palladino's analysis, the scientists who developed the techniques of Mendelian hybridisation became as professionally successful as they did largely because of their skill in presenting their breeding as rational, planned and scientific. So for Palladino, Mendelism played a role for academic plant breeders similar to that played by theories of disease and asepsis contemporaneously for medical practitioners. As Palladino puts it:

> The establishment of a particular relationship between the work of science (genetic research) and technological practice (plant breeding) may have been an artefact devised by historical actors, in this case a budding community of geneticists, to advance the institutionalisation and professionalization of their particular branch of scientific enquiry.[2]

Palladino further argues that as academic plant breeders used Mendelian genetics to make themselves appealing to civil servants, politicians and industry, they became estranged from the concerns of other plant breeders and farmers. What is more, the nationalised nature of the funding Mendelians secured marks for Palladino a radical discontinuity with previous breeders' work, enabling Mendelians to further separate themselves from the traditional concerns of the plant breeding community.

There is a great deal of overlap between the professionalisation and capitalisation theses. Both portray the use of science as a sort of fig leaf of respectability for activities which were actually aimed at securing money–either as returns of capital or as

[1] Palladino's interpretation echoes the classic US studies of professional institutionalisation of genetics in plant breeding contexts, Kimmelman [1983] and [1987] and Fitzgerald [1990].
[2] Palladino [1993], p. 322, see also Palladino [1990].

government funding–rather than improved varieties.[1] Undoubtedly there is much truth to both theses. However there is room for an extra layer of complexity in this picture, one that counters the extremities of Berlan and Palladino's arguments. On the one hand, science wasn't always used to protect intellectual property, in lieu of legislative methods, by ambitious breeders seeking to cut out seed saving and competitors. In the nineteenth century British plant breeders were up to something much more subtle. They were developing reputations, and in the process, using science. Berlan is glossing over details worth recovering by placing nineteenth-century British plant breeders into exactly the same category as the hybrid maize and terminator gene stories of the twentieth century. On the other hand, Mendelian academic plant breeders weren't entirely successful in cutting themselves off from the traditional plant breeding community. In the 1920s they were just as much concerned with their reputations amongst their plant breeding peers as were their predecessors. In both cases the shortcomings of the existing analyses, Berlan's tendency to draw continuity and Palladino's to draw discontinuity between nineteenth and twentieth-century breeders, can be overcome by paying closer attention to the moral nature of breeders' claims about their work and their varieties.

4. The role of science: the moral economy thesis.

I want to suggest that one important and previously overlooked area in which the relationship between science and plant breeding mattered was a moral economy of plant breeding. The term 'moral economy' is drawn from social historian EP Thompson (Thompson [1971]). For Thompson a moral economy described an alternative to the market economy when it came to setting the price of corn in British markets. He uses this distinction to provide analytic depth to the actions of groups of hungry men and women who responded to scarcities of corn in the eighteenth and early nineteenth century. Where other historians have described spasmodic mob riots caused by hunger alone, Thompson traces a much richer lineage to these collective actions. When groups of people gathered to demand corn to make bread, at reasonable prices, they were surprisingly organised and disciplined. Their actions often fitted a definite pattern, usually they acted in accordance

[1] For more on this analysis in the German case see Harwood [2005].

with traditional paternalist schemes which included the idea that the basic necessities of life should not be the objects of profiteering. The disappearance of this tradition and the mob's ability to demand a set price for corn, came, for Thompson, with the ascendency of the market economy, championed by the proponents of Adam Smith.

In the years since its coinage the term moral economy has been adopted by historians of science to describe the spheres in which the value of certain objects unavailable in the market economy are set. Such goods include intangible ideals such as empiricism, objectivity and accuracy and furthermore, means of regulating the relationships between scientists.[1] How can the notion of a moral economy help us better understand the role of science in making British plant breeding in the long nineteenth century profitable? My contention is that the value of breeders' varieties and reputations was gauged by an intricate system of publicity, shows and medals, reported on by a specialised press, and hosted by learned societies. The interactions which occurred in this world largely operated outside of the market economy. Furthermore, breeders' activities were at least partly codified by the morals of the plant breeding community in which they operated. The community which sustained this economy was very big, and included a mixture of professionals and amateurs from all sections of society. One of the economy's obvious features was the interaction between plant breeders and naturalists such as Charles Darwin and Joseph Hooker in the nineteenth century, and as we will see, these interactions continued into the 1920s with the rise of the professional plant breeding scientist. However, the moral economy was not absolute, as breeders became more commercialised they increasingly operated in the market economy and the concerns of their fellow breeders became less important.

The moral economy of plant breeding is the context of interaction between science and plant breeding which Palladino and Berlan have exposed but left largely unexplored. To that end the following case studies provide a window onto this historical feature of British plant breeding. We begin with the work of Major Hallett, a Brighton based wheat breeder. Berlan has pointed to Hallett's work as an example of a new type of commercial strategy for plant breeders. Hallett's work was not, however, a straight-forward rehearsal

[1] For further interpretations of moral economies in science see Kohler [1994], Daston [1995] and Gooday [2004], pp. 23-30.

of later hybrid corn and terminator genes; the breeding method he used was not effective in cutting out pirates and savers of seed. Being aware of this deficiency, Hallett also courted the approbation of the moral economy of plant breeding, his varieties were a regular feature in the agricultural press and at the meetings of the BAAS.

In the second case study we turn to a subtle interplay between moral and market economies in the case of Culverwell's Telephone pea. We will see the airing and resolution of a priority dispute between two sets of breeders, William Culverwell and the firm James Carter and Co., in the closing years of the 1870s. The relative scientific skills of the aggrieved parties formed a key part of the evidence put forward by both sides. In closing this case study we will see that by the last quarter of the nineteenth century the castigation of Carters in this dispute held less bite for a firm that was increasingly moving away from the moral economy and towards the market economy.

In the final case study we will see a major anomaly to this trend in the arrival of nationalised Mendelian plant breeding. The work of publically funded wheat breeder, Rowland Biffen, brings us closest to the conception of moral economy proposed by EP Thompson. Biffen skilfully fostered connections to the moral economy of plant breeding, where his supporters argued that the moral nature of his selfless public service justified the government funding he received. Throughout his career, Biffen's varieties were pirated by Carters. Yet, in 1925 with the release of a new variety, Yeoman II, Biffen was able to literally set the price of his new seed in a move indicating that for a brief period in the 1920s the moral economy of plant breeding was more important than the equivalent market economy.

5. Major Hallett's Pedigree Wheat.

> The attempt to raise a new variety of wheat more productive than the many old kinds, might have been thought until lately quite hopeless; but this has been effected by Major Hallett, by careful selection. (Darwin [1875], p246).

Perhaps the most infamous of nineteenth-century British plant breeding methods was the pedigree method employed by Major F. F. Hallett. Based in Brighton, Hallett worked to

improve wheat and barley varieties from the 1850s until the 1890s (Berlan [2000]). Hallett was well known to Darwin and made a star appearance, quoted in the epigraph above, in *The Variation of Animals and Plants under Domestication* (Darwin [1875]). His method was to start with one perfectly healthy seed and select the best seed from the best ear of its offspring every year for replanting. Hallett bred his seeds in fertile garden soils giving each plant as much space as it needed to develop fully. Breeding in these conditions, with his new method, Hallett increased the number of seeds and ears per plant and his varieties were incredibly high yielding. This yield would diminish, however, after two or three years of growth and replanting in normal agricultural soils. Hallett claimed the lack of continued selection was responsible for this degeneration. Farmers were advised by Hallett, "it is highly important to purchase fresh seed every year from Brighton where the selection is continued, and without which no 'breed' of anything can be kept up." (Hallett [1887]). In contrast, Hallett's detractors claimed it was the garden soils which had the most effect on his varieties' yields.

For Berlan, although the details of Hallett's story may differ from the hybrid maize story, the general pattern is the same; science was used as a means of protecting biological material which had traditionally circulated freely. In Hallett's claims that growers had to return to him each year, Berlan sees a natural antecedent to the poor seeds of hybrid maize. Berlan's views draw heavily from those of the world renowned botanist, and joint 're-discoverer' of Mendel, Hugo De Vries. De Vries's himself, in the second edition of his popular botanist's history of plant breeding, put the point like this:

> [M]ethodical selection was assumed to produce races which could only be kept up to their high standard by continuous selection. This point was of the highest practical interest to the breeder, since it kept the production of the seed-grains of his race in his own hands [...] and thereby enabled him to secure very considerable profits. (De Vries [1919] p.66).

Hallett's strategy was, however, only effective to the extent that he could convincingly argue that his skills in selection were superior. Otherwise anyone could copy this relatively straightforward method for themselves.

In 1860 Hallett adopted the word 'Pedigree' as a trademark and warned in his advertising, "Any infringements of this actionable, and will be severely dealt with". Hallett felt he was forced to adopt a trademark as he believed, "The scientific discovery of the *Law of development in Cereals*, not being either a process or a mechanical invention a patent could not be obtained", (Hallett [1887]). These trademarks were reproduced in Hallett's advertising, placed on the stem of pictures of his wheat (Berlan [2000]). However, the Major's use of trademark, rather than confirming Berlan's thesis, betrays the weakness of Hallett's position. This relatively weak legislation offered little protection. If Hallett's varieties had possessed the same biological properties as hybrid maize or terminator genes it would have been unnecessary.

In parallel with this attempt to secure formal rights Hallett also tried to secure informal attribution rights over the law of cereal development. This was the law which underwrote his method of selection. Accordingly he petitioned Charles Darwin to recognise his priority for this discovery. Indeed, the epigraph to this section was not a statement volunteered by Darwin.[1] Hallett was a skilled self promoter; his wheat appeared at the Great Exhibition of 1851, at the RAS and RHS's shows, in the agricultural press and, significantly, at the British Association for the Advancement of Science (Kropotkin [1993] p. 179). As we've seen, the meetings of the BAAS were an important site for breeders wishing to establish their scientific credentials. The paper Hallett gave to the Exeter meeting in 1869, on the law of cereal development, was well received. The paper's inclusion in the programme directly after a paper given by Maxwell Masters, then editor of the ubiquitous *Gardeners' Chronicle*, indicated the establishment's acceptance of Hallett's work (Hallett [1869]).

Despite his best efforts, Hallett was unable to stop competitors using his varieties. They were, in fact, remarkably long lived. Even in 1908, when De Vries first published on Hallett's work, long after the Major had died, at least some of Hallett's pedigree varieties were still available. In Hallett's work then, there was something more complex at play than simple biological appropriation, or legislative protection. Hallett was active

[1] See letters between Hallett and Darwin available at the Darwin Correspondence Online, Darwin Correspondence Project Database. http://www.darwinproject.ac.uk/entry-9982/ (letter no. 9982; accessed 23 December 2010).

in seeking the approbation of his fellow breeders by participating in their community, hoping this would somehow translate into greater profits.

6. William Culverwell's Telegraph and Carters' Telephone.

One particular incident even more clearly illustrates the operation of a moral economy formed around the plant breeding community of the nineteenth century.[1] In 1878 James Carter & Co introduced a new pea variety; Telephone, that they claimed was a single selection from the variety Telegraph. That is, just one selection of an individual, from which a new and distinct variety had been created. Then, as now, peas occupied a grey area between horticulture and agriculture, they were grown in gardens and hot houses for pleasure, but also in increasingly commercial market garden operations, established to feed the expanding cities. Reflecting that diversity, this case study illustrates the importance of science to breeders throughout their moral economy.

On the 27th June Telephone was issued a first class certificate by the RHS's Fruit Committee at Cheswick (RHS [1878]). In December Carters took an advert out in the *Gardeners' Chronicle*. Under the title, "Sterling Novelties", Carters' advert proudly announced the variety's first class certificate received at the RHS's, "crucial trial", (Carters [1878]). A three quarter page illustration of a pod of "Carters' Telephone", as it was ubiquitously known, accompanied the text. In Carters' *Vade Mecum* catalogue, published in the following year, Telephone was advertised with no less than three mentions of its first class status and glowing testimonials from several gardeners. (Carters [1879a]).

Carters' status as suppliers of seed to the Queen was displayed prominently on the front cover of the catalogue, as was their award of five gold medals at the Paris Exhibition. Furthermore, Carters began offering their own cash prizes for outstanding samples of the variety, to be displayed at the RHS's shows.

[1] This case was particularly important to Mendelians and their main intellectual rivals in Britain, the Biometricians, who claimed that the dispute over Telephone undermined the theoretical integrity of the Mendelian hybridisation discussed in section seven. See Charnley and Radick [2008].

Not everyone was happy with the arrival of Telephone. Sometime in the last week of January 1879, a Yorkshire breeder, William Culverwell, private gardener to M. Milbank Esq., wrote a letter to the *Gardeners' Chronicle* launching an attack on Carters and their new pea. Culverwell was the originator of another variety, Telegraph which he had produced by hybridisation between two other varieties; Daisy and Early Morn. In 1876 Carters had purchased the stock of Telegraph from Culverwell for a high one off price and it was from this stock that they claimed one of their breeders had selected the new variety, Telephone. Culverwell, in contrast, claimed that Telephone was not a new variety, but merely the wrinkled peas selected en masse from Telegraph, which gave both round and wrinkled peas. Culverwell felt that isolating the wrinkled peas from Telegraph would ultimately detract from the stock, since the wrinkled peas were reckoned to be more desirable than the round ones. In this way Telegraph would eventually become an inferior sample of the same variety. Culverwell felt that if this were to happen, his reputation, as the originator of Telegraph, which was largely known as Culverwell's Telegraph, would diminish as the quality of Telegraph diminished, while the quality of Carters' Telephone increased. For Culverwell, then, it was above all his reputation as a breeder that was at stake.[1]

Conversely Carters felt that the attack from Culverwell undermined their reputation. Their reply to Culverwell stated:

> We have never sought to disparage either Mr Culverwell or his Telegraph Pea; they are we believe both good of their kind–both the man and the Pea, therefore we cannot understand why he should wish to disparage either us or our Telephone Pea. (Carters [1879b]).

Several other gardeners, from across the country, weighed into the debate with their thoughts. One, Mr W. Iggulden, questioned Culverwell's claim on the basis of Telephone's RHS certificate, asking, "if they are synonymous how came the certificate of the Royal Horticultural Society to be awarded to Telephone?" (Iggulden [1879]).

[1] This letter is not present in RHS's copies of the *Chronicle* held in their Lindley Library, however its content can be inferred from later letters and Weldon [1902].

The debate then shifted to focus on each of the protagonists' scientific skill and knowledge of breeding. Carters accused Culverwell of having a poor knowledge of hybridisation, Culverwell retaliated that the three years in which Carters had owned Telegraph was never enough time to develop and bring to market a new variety. Culverwell even conducted his own experiment, in which he repeated the sort of single selection he believed Carters had used to create Telephone. The results, he claimed, vindicated his view that Telephone was merely a stock of the best seeds selected from Telegraph. Carters stuck to their story. Science was obviously important to all involved even if there was some confusion over how it was deployed.

Iggulden, Carters and Culverwell each sent the editors of the *Chronicle* samples of seeds to prove their point. But as yet another gardener, Thomas Keetley observed, "Comparison in ripe seed is no real test." (Keetley [1879]). Accordingly the *Chronicle* called a halt to the furore and refused to publish any more correspondence until the seed samples could be grown. Fittingly, the RHS's gardens at Chiswick (the site at which Telephone received its first class certificate) were chosen as the venue to perform comparative trials. Finally in August the *Chronicle* published its verdict on the case: Culverwell was in the right; Telephone was not distinctively different from the stock of Telegraph, but was merely an isolated sample of its wrinkled peas. The *Chronicle's* verdict was this, "To Mr Culverwell belongs the credit of raising and sending out Telegraph–an undoubtedly fine Pea, and it is to be hoped we shall hear no more of the name Telephone." (*Gardeners' Chronicle* [1879]). Credit was indeed at the heart of this dispute. Shows, prizes and certificates and the breeders' names with which they were associated were credited as evidence of a moral character which invited gardeners to trust.

Despite this incident, during the remaining years of the nineteenth century Carters expanded considerably moving into both the Australian and American markets. In 1910 they moved from Holborn to purpose built premises at Raynes Park, south London. Culverwell might have been vindicated in the short term by the *Gardeners' Chronicle* and the contributors to its letters pages but these informal means of protection seem to have been at least partially ineffective: Telephone is still available to buy today, Telegraph has long since vanished. On the other hand, Carters remained unpopular with one important new entrant to the moral economy of plant breeding. Rowland Biffen, a

Mendelian plant breeder, whose fame is a little faded now, but at the time rivalled and even surpassed that of the breeders we've encountered so far, felt Carters breeding techniques and commercial strategies were morally contemptible.

7. Rowland Biffen's Mendelian varieties.

The twentieth-century development of publically funded Mendelian hybridisation has often been identified as marking a radical break in the history of plant breeding.[1] Contemporary pundits claimed Mendelian hybridisation was more rational, planned and scientific than previous breeding methods. Concurrent with the growth of such thinking was the growth of a fledgling ideal of selfless public service amongst the researchers in receipt of public funds. Public service became an important element in the justification of increasingly nationalised seed production and distribution. For a glimpse of that ideal in action, consider the following extract from a speech made in 1924, introducing Rowland Biffen, to the London Farmers' Club. The speechmaker was Sir H. Trustram Eve KBE a planning consultant and agricultural reformer with some political influence:

> We practical business men, if we have an idea, try to make money out of it; it is human nature, but the scientific man is always working for others without advantage to himself […] There is no patent, there is no copyright in seeds, and yet our scientific friends are spending the whole of their lives in seeing how they can help the farmers of this country. (Biffen [1924a], p. 2).

This development certainly added a new slant to the moral economy in which previous breeders had operated.[2]

A statistical analysis of the success of Little Joss, Biffen's first successful variety, is very difficult to reconstruct from aggregated agricultural returns. However, when Biffen was given the Darwin Medal by the Royal Society in 1920 it was claimed that Little Joss

[1] See particularly Kingsbury [2009], or for a more nuanced view Olby [1991].
[2] For biographical details of Biffen see Engledow [1950] and Palladino [2002]. Biffen, in fact died with a personal fortune of £25,000 and one patent for a rubber extraction process to his name.

accounted for great swathes of the wheat acreage in Britain, (Nature [1920]). Biffen made little money directly from the sale of seed, many were given away to his friends, but Little Joss's success was still valuable to him. Two features of that success hark back to the previous case studies; the first is the shared location for its public demonstration. Biffen's varieties were publicly displayed and praised in very similar circles to Hallett's wheat or Carters' Telephone. The second is the close association between Biffen's varieties and their scientific underpinning. The theoretical frameworks applied to plant breeding by Hallett and Biffen might have been different, but in each case they operated with a similar ancillary effect, to support claims to the resulting varieties' superiority and reliability.

In 1911, William Bateson, the zoologist who had introduced Biffen to Mendel's work, and a longstanding member of the RHS, announced to the Agricultural sub-section M of the BAAS meeting at Portsmouth:

> Of the work which is making the Cambridge School of Agriculture a force for progress in the agricultural world the remarkable researches and results of my late colleague, Professor Biffen, based as they have been on modern discoveries in the pure sciences of breeding, occupy a high and greatly honoured place. (Bateson [1912] p.587).

In 1919 the RHS's vice president, Sir Daniel Morris, talking to Botany Section K of the BAAS's meeting at Bournemouth praised Biffen's work as, "essential to the welfare and safety of the nation", men like Biffen, "workers in pure science", were, he argued, required to solve, "those problems of national importance which confront us", (Morris [1920]).

At least some of the farming community were also supportive of Biffen's work. On 16th December 1921, Biffen and another professional breeder, Edwin Sloper Beaven, were given two silver bowls by the Essex Farmers' Club to recognise the success of their varieties.[1] Biffen made numerous appearances at farmers' clubs around the country.

[1] The John Innes Centre (JIC) in Norwich, UK still has Biffen's silver bowl in its collection along with newspaper cuttings kept by his wife, Mary, showing the wide

Often he was highly praised at such meetings, as at the Bedfordshire Chamber of Commerce where his visit elicited this response:

> Mr E Laxton said he thought the meeting did not recognize the great work that Mr Biffen had been doing for agriculture, but in a few years they would look upon him as one who had added to their incomes. [...] Mr Biffen was devoting his life and brains to bringing out new wheats that would add to the well-being of the country and of the world.[1]

Further links to farmers were made when Biffen and his varieties appeared at the RAS's shows. Biffen, who was the RAS's consulting botanist for 40 years, found his varieties a place in educational displays designed to encourage their use by farmers.[2]

Biffen even produced a catalogue in 1916 in collaboration with a local seed firm. In it Little Joss was advertised along with a new variety, Yeoman, which also became successful. By 1923 the government was officially recommending Yeoman's use:

> [T]he National Farmers' Union should recommend its members to produce "Yeoman" wheat […] Millers, for their part, should concentrate on the production, advertisement and sale of all Yeoman flour, while bakers should make enlightened use of its proved and recognised qualities. (MAF [1923], p.86).

In the *Journal of the Ministry of Agriculture* in September 1924, an announcement, authored by Biffen, proclaimed the release of a new variety. The new strain, Yeoman II, was a remedy for the impurities of old Yeoman stocks. At the end of the article, Biffen

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coverage the event received, see the JIC's Biffen Collection. On Beaven and his revealing doubts about Mendelism see Palladino [1994].

[1] See the circa. 1910 newspaper extract, "Bedfordshire Chamber of Agriculture: important lecture by Prof. Biffen on the future of wheat growing," Mary Biffen's Scrapbook, p.3, Biffen Collection, John Innes Centre Archives.

[2] Biffen was also well known to the RHS both professionally, he gave the Society's Maxwell Masters lecture in 1913–an honour he shared with De Vries–Biffen [1913], and personally through the flower breeding for which he and his wife Mary received prizes see Taylor and Wilkinson [2008?] and Taylor, Wilkinson and Hammett [2009?]

laid claim to the most obvious form of protection placed upon the release of Yeoman II, the seal to be placed on the sacks in which it would be sold: "The attention of farmers is particularly drawn to the fact that genuine seed of Yeoman II can only be obtained in sacks closed with the seal of the National Institute of Agricultural Botany." (Biffen [1924b], p. 512). Tenders were only to be made to the NIAB, a new institution, partly funded by government money, at which Biffen was initially honorary vice president, and later Chief scientific advisor. The seed was certified as genuine and superior by the NIAB seal on the sacks it was sold in. What is more, the price of the new seeds in any subsequent transactions or re-sales was set by Biffen and NIAB on the explicit understanding that this would prevent profiteers from acting immorally; by barring them from profiting from the products of public funds, and also barring them from profiting on the nation's food supply–which had been the cause of much concern since the Great War.[1]

Despite this success in promotion and protection, Biffen still did not have complete control over his varieties. Carters began selling an 'ennobled' Yeoman Master variety and their own strain of Little Joss very quickly after their first appearances. While this irked Biffen greatly even with the new NIAB maintained system of pricing and distribution in place there was little he could do to counter such piracy. In the end Biffen even resorted to the odd bit of veiled sniping, as in 1926, "Wheat selection, however, is still practised, or said to be practised by the seed trade, but it is improbable that their efforts will lead to any improvement in the crop if the story of one of the most recent "pedigreed" wheats, A's "X.Y.Z," is typical of the modern methods of selection." (Biffen and Engledow [1926] p.9). Biffen was clearly scornful of Carters and their alleged piracy. This sort of piracy was much less threatening, however, to him than it was to Culverwell at least partly because his breeding was now securely funded. Thanks to his friends at the RAS, RHS, BAAS and then NIAB, Biffen's attribution rights over Little Joss, Yeoman and Yeoman II were far more secure than Culverwell's grip on Telegraph. As such Biffen was much less susceptible to the type of damage Culverwell feared Telephone might do

[1] See the discussions of the Crop Improvement Committee, responsible for the release of Yeoman II. Biffen and his supporters led the committee's agenda for the release. See, "Minutes of the Crop Improvement Committee", from 24th May 1923 onwards, Archives of the National Institute of Agricultural Botany.

to Telegraph and his own reputation. Biffen's belief in the moral nature of plant breeding is underlined by his cautious admiration of Hallett. De Vries, as we have seen, was suspicious of Hallett, but Biffen, in contrast, explicitly vindicated the older breeder's moral character. Biffen did not believe in the power of selection to change anything, but he saw something admirable in Hallett's work. It was useful, he felt, because, "an honest account of his methods was given at the very outset. Such cannot be said of the work of some of his followers." (Biffen and Engledow [1926] p.8).

8. Concluding reflections.

In the three case studies presented here we have seen a subtle moral dimension at work. In Major Hallett's case his varieties had weak biological protection and weak legal protection; this pushed Hallett into seeking approbation from the plant breeding community for the scientific credentials of his methods. In Culverwell and Carters' case, even when there was little money directly at stake for Culverwell, he was greatly concerned with maintaining Telegraph's reputation, and his own, against a perceived threat. In his dispute with Carters we saw something of the diversity and yet weakness of the moral economy which formed around plant breeding. Finally in Biffen's case we saw how a moral dimension to plant breeding was rekindled in Biffen's work to promote and protect his new, publically funded, varieties. For each of the breeders considered here the moral judgements of their peers carried some weight.

Two types of lesson emerge from these studies. The first type relate to our understanding of nineteenth-century plant breeding. With the concept of a moral economy in mind we are better placed to understand the differences between a breeder like Hallett's work and the later developments of hybrid maize or terminator genes. Nineteenth-century breeders were forced into a sort of collaboration which hybrid maize or terminator genes allowed later breeders to avoid. Bearing this concept in mind also helps us see that Biffen's work and the ethos of selfless public service associated with it drew much from the work of previous breeders. The existing capitalisation and professionalisation theses, drawn from Marxian and social constructivist traditions respectively, having brought us this far in understanding these subjects, might usefully be

supplemented with a more nuanced understanding of plant breeders' views on the moral nature of their work.

Finally, there are lessons to be gleaned here for our understanding of intellectual property and innovation more generally. Without patents or copyright to provide protection, plant breeders in the long nineteenth century produced a wealth of new varieties. So, the case studies in hand lend general support to those seeking to revise the view that patents were, and still are, a necessary and effective stimulus to innovation. In this patent-free context many breeders, working with the constraints offered by plants and the resources offered by their institutional environment, focused their efforts on securing credit and attribution rights, and building reputations. This paper has revealed the importance of science and morality to these breeders who were attempting, by sub-patent means, to protect and profit from their innovations.

Figure 1: Advert for Telephone and Telegraph peas taken from Carters' *Illustrated Vade Mecum and Seed Catalogue,* 1879. The catalogue was also intended to function as a handbook, a *vade mecum,* which translates literally as 'go with me'. Image supplied by the RHS, Lindley Library. © RHS.

References.

Allen, R. [1983], "Collective Invention", *Journal of Economic Behaviour and Organisation,* 4, p.1-24.

Bateson, W. [1912], "Chairman's Address to the Agricultural Sub-Section," *Report of the 80th Meeting of the British Association for the Advancement of Science; Held at Portsmouth in August and September 1911,* Sub-Section M–Agriculture, p.587-596.

Berlan, Jean-Pierre. [2000], "The Political Economy of Agricultural Genetics," in Rama S. Singh *et. al.* (eds.), *Thinking about Evolution: Historical, Philosophical, and Political Perspectives,* p.510-528. Cambridge University Press, Cambridge.

Biffen, R. H. [1913], "Investigations on the control of Disease in Plants", *Journal of the Royal Horticultural Society,* 34, p.313-323.

Biffen, R. H. [1924a], "Modern Wheats," *Journal of the Farmers' Club,* Part 1, p. 2-18

Biffen R.H. [1924b], "The New Wheat Yeoman II." *Journal of the Ministry of Agriculture,* 31, p.509-512.

Biffen, R. H. and Engledow, F.L. [1926], *Wheat-Breeding Investigations at The Plant Breeding Institute, Cambridge", Research Monograph, No. 4*, Ministry of Agriculture and Fisheries, London.

Biagioli, M and Galison, P. [2002], *Scientific Authorship: Credit and Intellectual Property in Science*, Routledge, New York.

Boldrin, M and Levine, D. [2008], *Against Intellectual Monopoly,* Cambridge University Press, Cambridge.

Brassley, Paul, [2000], "Crop Varieties", in E.J.T. Collins, (ed.) *The Agrarian History of England and Wales, 1850-1914,* 8 Vols. (VII:1) Cambridge University Press, Cambridge, p.522-532.

Carters. [1878], "Sterling Novelties," *Gardeners' Chronicle,* 28th Dec. p.825

Carters. [1879a], "Carters' Telephone Pea," *Carter's Vade Macum,* James Carters & Co. London.

Carters. [1879b], "Culverwell's Telegraph and Carter's Telephone Peas," *Gardeners' Chronicle,* 1st Feb. p.148.

Charnley, B. and Radick, G. [2008], "Plant Breeding and Intellectual Property Before and After the Rise of Mendelism: The Case of Britain," in Daniel Kevles, Jean-Paul Guadilliere and Hans-Jorg Rheinburger, (eds.), *Max Planck Institute for the History of Science Pre-print Series,* p.51-55, Max Planck Institute, Berlin.

Church, Roy, [2000], "Advertising Consumer Goods in Nineteenth-Century Britain: Reinterpretations", *Economic History Review,* 53, p.621-645.

Darwin, C. [1875], *The Variation of Animals and Plants under Domestication: Volume 2,* John Murray, London.

Daston, Lorraine, [1995], "The Moral Economy of Science", *Osiris,* 10, p.2-24.

De Vries, H. [1919], *Plant Breeding,* The Open Court Publishing Company, London.

Dutton, H. [1984], *The Patent System and Inventive Activity during the Industrial Revolution, 1750-1852*, Manchester University Press, Manchester.

Elliott, B. [2004], *The Royal Horticultural Society: A History 1804-2004*, Phillimore, Stroud.

Engledow, F. L. [1950], "Rowland Harry Biffen. 1874-1949," *Obituary Notices of Fellows of the Royal Society*, 7, p.9-25.

Fritzgerald, Deborah, [1990], *The Business of Breeding: Hybrid Corn in Illinois, 1890-1940*, Cornell University Press, Ithaca.

Gardeners' Chronicle. [1879], "Telegraph and Telephone Peas," *Gardeners' Chronicle* 2nd Aug. p.146.

Gooday, G. [2004], *Morals of Measurement: Accuracy, Irony, and Trust in Late Victorian Electrical Practice.* Cambridge University Press, Cambridge.

Hallett, F. [1869], "On the Law of the Development of Cereals" *Report of the 39th Meeting of the British Association for the Advancement of Science; Held at Exeter in 1869*, Section K – Botany, p.113.

Hallett, F. [1887], *The Agricultural Gazette*, 31st Oct. p.424.

Harwood, J. [2005], *Technology's Dilemma: Agricultural Colleges between Science and Practice in Germany 1860-1934*. Bern: Peter Lang.

Iggulden, W. [1879], "Culverwell's Telegraph and Carter's Telephone Peas," *Gardeners' Chronicle*, 1st Feb. p.148.

Khan, B. Z. [2005], *The Democratization of Invention. Patents and Copyrights in American Economic Development, 1790-1920*, Cambridge University Press, Cambridge.

Keetley, T. [1879], "Culverwell's Telegraph and Carter's Telephone Peas," *Gardeners' Chronicle*, 8th Feb. p.180.

Kevles, D. [2007], "Patents, Protections, and Privileges: The Establishment of Intellectual Property in Animals and Plants," *Isis*, 98, p.323-331.

Kevles, D. and Glenn E. Bugos, [1992]. "Plants as Intellectual Property: American Practice, Law, and Policy in World Context," *Osiris*, 7, p.75-104.

Kimmelman, Barbara A, [1983], "The American Breeders Association: Genetics and Eugenics in an Agricultural Context, 1903-1913," *Social Studies of Science*, 13, p.163-204.

Kimmelman, Barbara A, [1987], "A Progressive Era Discipline: Genetics at American Agricultural Colleges and Experiment Stations, 1900-1920," Unpublished PhD Thesis, University of Pennsylvania.

Kingsbury, Noel [2009], *Hybrid – The History and Science of Plant Breeding,* University of Chicago Press, Chicago.

Kloppenburg, Jack, [1988], *First the Seed: The Political Economy of Plant Biotechnology,* Cambridge University Press, Cambridge.

Kohler, R [1994], "Moral Economy, Material Culture, and Community in Drosophila. Genetics", in Mario Biagioli (ed.), *Science Studies Reader,* p. 43-58, New York, Routledge.

Kropotkin, P. [1993], *Fields Factories and Workshops,* Transaction Publishers, London.

Lupton, F. G. H. [1987], "History of wheat breeding," in F. G. H. Lupton (ed.), *Wheat Breeding: Its Scientific Basis,* pp.51-70. Chapman and Hall, London.

MacLeod, C. [1991], "The Paradoxes of Patenting: Invention and its Diffusion in 18th and 19th Century Britain, France, and North America," *Technology and Culture*, 32:4, p.885-910.

MAF. [1923], *Ministry of Agriculture and Fisheries, Departmental Committee on Distribution and Prices of Agricultural Produce: Interim Report on Cereals, Flour and Bread, [13th Dec. 1922-9th Oct. 1923],* HMSO, London.

Morris, Sir Daniel. [1920], "Address to the Department of Botany," *Report of the 87th Meeting of the British Association for the Advancement of Science; Held at Bournemouth in September 1919,* Section K – Botany, p.316-331.

Moser, P. [2004], "Determinants of Innovation - Evidence from 19th Century World Fairs," *The Journal of Economic History*, 64, p.548-552.

Moskowitz, M. [2008], "The limits of globalization? The horticultural trades in postbellum America," in: Nützenadel, A. and F. Trentmann, (eds.), *Food and Globalization: Consumption, Markets and Politics in the Modern World,* Cultures of consumption series, Berg, Oxford.

Murphy Denis J. [2007], *Plant breeding and biotechnology: societal context and the future of agriculture.* Cambridge University Press, Cambridge.

Nature. [1920], "Anniversary meeting of the Royal Society," *Nature,* 106, p.452-3.

North, D. [1981], *Structure and Change in Economic History,* Norton, New York.

Nuvolari, N. [2004], "Collective invention during the British Industrial Revolution: the case of the Cornish pumping engine," *Cambridge Journal of Economics*, 28, p.347-363.

Olby, R. [1991], "Social Imperialism and State Support for Agricultural Research in Edwardian Britain," *Annals of Science*, 48, p.509-526.

Olby, R. [2000], "Mendelism: from hybrids and trade to a science," *C.R. Acad. Sci. Paris, Sciences de la vie / Life Sciences*, 323, p.1043-1051.

Olmstead, Alan L. and Paul W. Rhode [2008], *Creating Abundance: Biological Innovation and American Agricultural Development,* Cambridge University Press, Cambridge.

Palladino, P. [1990], "The Political Economy of Applied Science: plant breeding research in Great Britain, 1910-1940," *Minerva,* 28, p.446-468.

Palladino, P, [1991], "The Professionalisation of Plant Breeding in the United States: The Technology of Hybridisation and its Consequences", *Minerva,* 29, p.507-515.

Palladino, P. [1993], "Between Craft and Science: Plant Breeding, Mendelian Genetics and British Universities, 1900-1920," *Technology and Culture,* 34, p.300-323.

Palladino, Paolo. [1994], "Wizards and Devotees: On the Mendelian Theory of Inheritance and the Professionalization of Agricultural Science in Great Britain and the United States, 1880-1930," *History of Science,* 32, p.409-444.

Palladino, P. [2002], *Plants, Patients and the Historian: (Re)Membering in the Age of Genetic Engineering,* Manchester University Press, Manchester.

Pauly, Philip, J. [2007], *Fruits and Plains: The Horticultural Transformation of America,* Harvard University Press, Cambridge; Mass.

RHS. [1879], "Awards of the Fruit Committee at the Cheswick Trials, 1878," *Proceedings of the Royal Horticultural Society*, n.s 5, p.xciv.

Rangnekar, D. [2000], "Innovative Appropriation: The Role of Law, Economics and Science in Transforming Plants into Products –A Case Study of Wheat Breeding in the UK," Unpublished PhD Thesis, Kingston University.

Roberts, H. F. [1929], *Plant Hybridisation Before Mendel,* Princeton University Press, Princeton.

Singh, Rama S. *et. al.* (eds.), [2000], *Thinking about Evolution: Historical, Philosophical and Political Perspectives, a Festschrift for Richard C. Lewontin,* Cambridge University Press, Cambridge.

Taylor, J. and Wilkinson, S. [2008?], "Miss Evelyn Hemus", *Horthistoria,* <http://horthistoria.com/?p=217> (accessed 6th June 2010).

Taylor, J., Wilkinson, S. and Hammett [2009?], "Miss Hilda Hemus", *Horthistoria,* <http://horthistoria.com/?p=219> (accessed 6th June 2010).

Thompson, EP, [1971], "The Moral Economy of the English Crowd in the Eighteenth Century", *Past & Present*, 50, p.76-136.

Weldon, W. F. R. [1902], "Mendel's Laws of Alternative Inheritance in Peas." *Biometrika,* 1, p.228-254.

Zirkle, Conway, [1935], *The Beginnings of Plant Hybridization,* Cornell University, Oxford University Press, London.