Chapter 9

Plants are technologies

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Introduction

As the introductory chapter makes clear, historians of technology and the environment have already shifted towards seeing nature and technology as complexly integrated. My chapter concerns the extent of that integration. I tackle one issue in particular, that of how to understand the organism as technology. This question is a source of lingering uneasiness. For example the recent and provocative *The Illusory Boundary* is dedicated to integrating technological and environmental history. However, the authors of its final survey chapter, Hugh S. Gorman and Betsy Mendelsohn, while emphasising the above shift also highlight an attendant ambiguity, that in this new scholarship "it is not always clear where the machine ends and nature starts."[1] Meanwhile co-editor of that volume, Martin Reuss, does not address organisms directly, but concludes that as a result of this work the "Imagined boundaries between technology and environment shift, splinter, and dissolve into meaninglessness".[2] Given his misgivings about the organism as technology, as articulated in a 2001 email list discussion that many historians have considered important for building the 'envirotech' space, does his conclusion indeed hold for biological things?[3] I argue that when it comes to organisms, historians have not reached meaninglessness, that rendering such a distinction 'meaningless' is not really the aim, but that we can and should analyse organisms as technologies. Doing so expands the scope of historical enquiry by revising unhelpful assumptions while also making historical discussions relevant to a wider (non historical) readership.

Writing of organisms and environments as though comparable to, or analogically related to, or essentially the same as, technological things and systems, is not inherently

reductive or impoverished in comparison to other forms of analysis and writing. It absolutely can be, of course, but not out of necessity. Prejudices towards this analytical perspective are born of assumptions about the consequences of defining something as a technology. Defining something as a technology does not erase its other identities, or make it fundamentally easier to understand, other than to open up the kinds of question that might be asked and the parallel cases that might be explored. Again, that people do often define organic things as technologies in order to achieve precisely such a simplification is also unequivocally true. In sum, at the same time as I am addressing concerns about understanding organisms as technologies, I am also challenging the idea that technology cannot or should not inspire the same kinds of writing, analysis, or reflexivity that is more commonly directed to environmental things.[4] I would not expect any of the latter to come as a surprise to historians of technology, but for the person approaching this volume with a primary interest in the environment, I hope my unpacking is of use. Conversely, for the reader more heavily invested in the history of science and technology, I want to directly connect this volume to the social, political and scientific context in which it is published.

That plants are technologies is today a widely held position by economists, scientists, lawyers, companies, and biological engineers.[5] It is also very widely held by historians, though what these different people are trying to achieve when making the case that plants are technologies rarely aligns. Even within historical scholarship there is considerable diversity in how such an argument can or should be made, and little effort to compare or synthesise accounts.[6] In part this problem is caused by the multiple ways in which technology has been defined by actors in the past and can be defined by historians and philosophers in the present.[7] When it comes to organisms, for different historians it is sometimes the case that only certain plants become technologies (by being technologised), other times plants are integrated into a technological system (leaving the plant's status unaccounted for), other times plants or animals are nature's technologies[8] (wheat as a solar-powered explosive, cows as turbo-charged milk makers[9]). Matthew Holmes in the present volume (Chapter 8) develops yet another sense of plants as technologies, looking at breeding methods and emphasising how some scientists and breeders responded to the expectations of broader industrial systems in ways that ensured their plants incorporated that same industrial ideal. Most commonly plants are made technologies simply and

straightforwardly by the fact of human intervention. The latter approach is suggested in the introductory chapter to this volume, channelling Edmund Russell:

> ...technologies are modified environments just as nature is to varying extents engineered...Likewise, organisms 'become tools when human beings use them to serve human ends'.[10]

Without further clarification of what this statement is intended to mean we risk being read as supporting a narrower range of social, economic, and political positions than research at the intersection of technology and environment might actually inspire. Historians cannot ignore the fact that 'plants are technologies' has not emerged only from the pursuit of their own scholarly agendas, but is also deeply bound up with political, economic, and scientific developments in our times. 'Plants are technologies', or similar sentiments, are repeated in almost ritualistic fashion within an ever expanding range of public and policy debates, be they on genetically modified organisms, agricultural industrialisation, biodiversity, biotechnology, intellectual property, or the environment. Indeed for at least one section of contemporary bioscience the concession that organisms are technologies has been a founding principle, provoking reactions from ethicists, social scientists, innovation policy makers, philosophers, governments, and everyone in-between.[11] My chapter directly addresses the position that plants are technologies out of frustration with its ubiquity.

I will demonstrate what 'plants are technologies' can do for the intersection of technology and environment by adopting it, while also making my meaning explicit. I mean that as with any technology, plants; 1) constitute suitable subject matter for broad debate as to their adequacy in meeting a range of social, economic, and political goals; 2) are used to accrue different forms of expertise and a concomitant social status by different experts; 3) are social and cultural artefacts. Many more specific meanings of technology could be included, these are merely the three tackled here. Do these three meanings belong only to technology, or do they apply to most anything?[12] Perhaps they do, but then, as I am already committed to techno-environmental history making, the breadth follows quite naturally. If one wishes to set themselves the challenge of finding 'what and only what' they can learn from study of 'the environment' or 'the technology' they are free to do so, and no doubt

much of interest awaits to be discovered. But these makings of environment and technology independent of one another will still remain co-optable in a range of different social and political debates. The role of history and historical scholarship in these contemporary discussions is of immediate importance. My primary aim is to raise the game regarding 'biology as technology' and the chapter can be used as such, to be compared and contrasted with other accounts, so that vacuous gestures towards 'biology as technology' as somehow inherently meaningful are more easily spotted, so that nobody can say "wheat is a 10,000 year old technology" again without also having to consider all that statement's implications, and so that different political, economic and social loadings of 'biology as technology' become all the easier to identify.

The history I have selected concerns the potato in Britain at the turn of the twentieth century in the hands of farmers, breeders, state funded investigators, and a Mendelian. This study informs how different organisms found in modern Britain relate to one another, and their significance as part of the environment as totems of progress, or degeneracy, or anything in between (on competing visions for agricultural modernity see David Matless, Chapter 6 this volume). There are three sections dedicated to three technological themes. First, the potatoes' significance as a site of governance, just as other technologies are. This section is dedicated to what kinds of organism are considered suitable for inclusion in British fields and how such decisions are made. One payoff in our own time is that organic things are found to invite social, legal and regulatory intervention regardless of any designation as high-technology (or 'biotechnology'), while the case also demonstrates how specific plant technology negotiations come to matter broadly by intruding on more fundamental social and political arrangements. Second, the potatoes' significance as a tool for making expertise, just as other technologies are. This section concerns how the environment is known and by whom. Here our historical plant technology case helps emphasise the need to open up the governance and investigation of social, technical and environmental issues.[13] Third and finally, that their significance as technical artefacts did not and does not alter their status as social and cultural artefacts, just as being a technology does not alter that status for other technologies. Here I focus on the techno-cultural significances of potatoes in terms of their commercial breeding. By the end I hope to have diminished uneasiness, or at the

very least, sufficiently sabotaged the position that 'plants are technologies' for those with more narrow social, economic, and political goals.

We are about to transition into the case study. Numerous reviewers warned me that it comes as something of a shift in tone following the introduction. I have not found a satisfactory solution. Perhaps then, another way to prepare you for what follows would be to say 'so you think biology is technology? OK. Good. Let's see what that means'.

Section One: Potato governance

Plants have been recognised and dealt with as technologies suitable for the attention of the modern state for well over a century. Here I lean on Esa Ruuskanen (Chapter 2), and also build by recognising the need to look simultaneously at numerous progressive agendas, be they for the improvement of the land, or methods and tools, or organisms. If we look at the UK government's primary agricultural publication, *The Journal of the Board of Agriculture*, at the turn of the twentieth century, we find that the potato, its nature and capacities, were being tested by agricultural investigators working in a wide range of sites in the UK and abroad. Reports include the experimental efforts of the Agricultural Department of the Irish Land Commission spraying a mixture of copper sulphate and lime (most widely referred to as Bordeaux mixture) on potato plants as a preventive to disease, the French authority M. Girard looking into the potatoes' "meat-producing value" as feed for livestock, and local reports of tests of varieties and planting methods.[14] "The objects in view" explained a report on work undertaken by Cheshire County Council in 1898 "were to test the productiveness, character, and yield of a number of varieties; to test the advantages of planting whole sets, cut sets, and sets of different sizes; and to try the effect of artificial manures when applied with farmyard manures."[15] These articles are indicative of the culture of agricultural research in Britain at the turn of the twentieth century, with little in the way of nationally funded research, and in which multiple small and locally oriented sites pursued independent investigations. The Board of Agriculture (BoA), formed in 1889, played a role in disseminating the results of such initiatives, and was soon able to offer small amounts of sponsorship, awarding newly available funds to County Councils to pursue agricultural

investigations and improve education.[16] Further growth in support of a system for British agricultural development followed in the coming decades, and was seized upon by those looking to institutionalise agricultural science.[17]

Around 1900 the annual potato crop in England covered somewhere between 380 and 400 thousand acres, 27 to 30 thousand in Wales which when combined with Scotland amounted to a total of around 500 thousand acres throughout Britain.[18] Producers could be found all across these countries, though high levels of potato farming were concentrated in England in the Eastern Counties, East Anglia, Yorkshire, and Lancashire, while Scotland was also an essential producer of seed potatoes. As we shall see, investigations into the potato pursued by cooperative organisations, colleges, and local authorities commonly addressed diseases and their outbreaks, eventually resulting in legislation dealing with the zoning and containment of organisms within infected regions, and restrictions on their sale.[19] In the case of potato wart disease, the state came to build on and eventually take over activities begun in private. Wart, sometimes referred to as Black Scab, drastically reduced potato yield, sometimes to nothing. Some of the most well recognised commercial varieties were susceptible, including the King Edward. The most important example of private initiative, and one which helps demonstrate that plants are technical levers by which different forms of governance can be applied, is that of the Ormskirk Poor Law Institution (workhouse), whose trials were eventually taken over by the BoA, expanded, and reconstituted as the responsibility of a new Ormskirk Potato Testing Station. In this section plants are technologies because they are material points upon which communities, experts, and the state can exert pressure, in the process redistributing power and renegotiating the environment.

The fullest available account of the origins and early work on wart at Ormskirk is an article published in 1919 by George C. Gough in the *Journal of the Royal Horticultural Society*. Ten years earlier Gough had visited Ormskirk as an Inspector of the Board, having been made responsible for conducting a national survey of potato wart disease. On reporting to the BoA that the disease was indeed widespread and particularly prevalent in areas such as Lancashire and Cheshire, the BoA sponsored some official trials.[20] These included variety trials, as it had already been recognised by farmers and breeders that certain varieties were immune to the disease. Indeed Gough acknowledges the role played

by local farmers and breeders in organising early investigations into wart disease, as they had done at Ormskirk in partnership with the Lancashire Farmers' Association. The workhouse setting is also significant as the inmates (some ill and temporarily admitted, others itinerant and passing through) were required to perform duties around the building and grounds, including working on the farm. The farm supervisor and gardener, Preece, had around 8 acres to manage including field strips used for potato testing. For the inmates, working on the farm was just one of a number of ways in which they were expected to pay for the food and lodging they received.[21]

Cooperation between growers, breeders and representatives of the Board was characteristic of the governance of potato diseases at the outset. This locally focused and voluntarist approach would continue to matter greatly even as it came under increased pressure from two interrelated influences: the threat and eventual outbreak of the Great War and the institutionalisation of genetics, addressed in section two. Building on these initial trials, steps were taken towards greater levels of state intervention regarding safe and proper potato growth, though it was immediately recognised that such legislation could be highly controversial. Decisions as to how best to deal with wart disease incorporated decisions as to proper farming, where authority might lie between individuals, County Councils and the BoA, the administration of different countries (England, Wales, Scotland and Ireland) as part of the empire or something otherwise, and ultimately of course what kinds of plant were acceptable for inclusion in the Great British landscape. Such questions of governance are already explored in historical and social scientific research into science, and can motivate historical investigation of the environment, looking at changes in understandings and valuations of nature as embodied in legislation and any attempted ameliorative measures.[22]

The first Wart Disease of Potatoes Order was issued in 1912, and would be regularly reissued or updated throughout the period to the end of the Second World War. In the first instance it required that notices be placed throughout potato growing regions through the public press, sent to allotment holders, and smaller growers, explaining that it was their responsibility to report all cases of wart. With the help of BoA Inspectors, and in some cases the police, potato growing districts were subject to inspection. As the BoA described, "This led to the discovery of a very large number of cases in allotments and cottage gardens".

They go on to write that "In two instances only was it necessary to take legal proceedings. In one case a workman at Perry Barr, Staffordshire, was convicted and ordered to pay costs. In another an occupier of a garden in Worcestershire was fined ten shillings and costs."[23] That so much time and attention was directed to small growers working in their home gardens might evidence what were considered to be the necessary minimum steps to ensure wart did not spread outward from infected regions, but also perhaps the extent to which the Board sought to demonstrate to farmers that they were not the only ones whom this legislation inconvenienced. Further measures then focused on ensuring that within infected regions only varieties that had been determined immune (by tests verified at Ormskirk, Harper Adams, and in some cases the laboratories at Kew Gardens) were planted.[24] Here we can see how plant technologies are used to consolidate or redistribute state powers and institutional responsibilities.

In this new governmental arrangement proven immune varieties would rapidly increase in popularity in those zones scheduled as wart infected, and the process of deciding which varieties were immune - including those novel varieties annually introduced to the marketplace - ceased to be of only local interest, but became an obviously powerful gatekeeping process, one which could determine whose varieties had access to these captive consumers. From 1913 onwards then, the breeders and farmers at Ormskirk, in collaboration with a Mr John Snell (BoA Inspector stationed in Lancashire) took on the responsibility of trialling and issuing reports on immunity, organising an annual varietal showcase. We can better understand what the latter was like through a detailed newspaper report published in *The Preston Guardian* in 1920.

> This week Ormskirk has been the Mecca of men from all parts of Britain interested in the scientific as well as the commercial aspects of potato culture...to see the Ormskirk Potato Society's annual exhibition, which is held under the joint auspices of the Lancashire and South Westmorland Farmers' Association (who have supported this work from the inception of the trials), the Ministry of Agriculture, and the National Institute of Agricultural Botany. The show is not only increasing in magnitude, but arousing wider interests, which occasions no surprise in view of the recurrent outbreaks of wart disease and the significant remark of Sir Arthur Griffith-

> Boscawen, Parliamentary Secretary to the Ministry, at the opening ceremony, on Wednesday, that before many years had elapsed nothing but immune varieties would be grown in the country. There were over 300 entries of immune varieties sent for competition in the 27 classes, but, as in past years, the great educational feature of the exhibition was the display of over 500 varieties grown in the Ministry of Agriculture's trials at Ormskirk showing new seedlings or old varieties not previously tested which have matured in the infected soil and been lifted without a blemish, and indicating very plainly by the offensive-looking fungoid growths the "susceptibles" that will have no legal right to be found in the scheduled areas.[25]

That the significance of Griffith-Boscawen's prediction was seized upon is indicative of the close watch given to the potential for government intervention. It is also clear from the general description of the event, and the accompanying photograph of organisers (Figure 9.1), representing trade, farming, government, and scientific institutions, that Ormskirk's success as a recognised and reliable site for varietal trialling was dependent on maintaining cooperation across all social and industrial levels of potato interest. Less clear is the extent to which any of these actors interpreted zoning legislation in terms we might recognise as environmental. Zoning measures remain to be placed in context of the longer history of environmental regulation.[26]

Pictured amongst the organisers of that year's show (FIgure 9.1) are four people whose significance will be dealt with in the next section thanks to what they can tell us about the potato as a technical object. In truth I will be focusing mainly on the first of these, R.N. Salaman (back row, fourth from left), thanks to a wealth of archival material associated with him. The others, W.H. Parker (back row, third from left), H. Bryan (back row, second from left), and N. Whitehead (back row, first on the left), have the potential to be all the more revealing, though will be dealt with only briefly. Incidentally, these four people are all stood together for a reason.

Section two: Potato knowing

Alongwith changes in their governance, the early twentieth century was characterised by newly invigorated debates as to what constituted a proper potato variety. As we see in Mat Paskins argument regarding modern British forestry (Chapter 12), different imaginaries of the state were exhibited in different practices of knowledge and calculation, occurring at both local and national levels. In this section, rather than beginning with institutions for the poor, we instead find a Mendelian working at home in his own private gardens in Barley, Hertfordshire. There, Dr Redcliffe Nathan Salaman, M.D. began in the early 1900s (at almost exactly the same time as Ormskirk began to pursue its first variety trials) investigations into potato varieties, diseases, and breeding. He had no botanical training, initially having trained as a medical doctor. Soon after earning this qualification however he contracted tuberculosis, moving out of London to the countryside for the benefit of the country air (see Jennifer Wallis, Chapter 5, for the history of the garden in the medical machine). In the process he switched to investigations of breeding. What Salaman might tell us about the early history of genetics and the environment has not yet been explored, though some time ago Paolo Palladino noted the uniqueness of his 1949 *The History and Social Influence of the Potato*, which contains a number of different arguments and theories as to the relations between humans, food supply, and their surroundings (including theories about the potato as a means for keeping Ireland in a state of peasantry).[27] He is a prime candidate for examination in histories of UK agriculture thanks to his prodigious output, the positions that he came to adopt in key agricultural science institutes (including the National Institute of Agricultural Botany and the Potato Virus Research Station), his arguments on race and eugenicism, and because through him we can reach agricultural development and its meanings across the British Empire and at other crucial sites, particularly the Middle East and the state of Israel at its founding. None of this can be covered here, it is simply enough to say that thanks to his work on the potato Salaman entered into correspondence with people invested in different kinds of agricultural improvement all around the world, and took on particular responsibilities in the Middle East through the Hebrew University, the laying of the foundation stone for which he had personally witnessed as an enlisted man in the British 39th (Labour) Battalion - or 2nd Battalion of Judeans - shipped to Palestine in 1918. Techno-environmental histories of Britain can therefore also be of other places. In this section I instead focus on Salaman's broad interests in genetics. Aside from being amongst

the first 6 people to be published in the new *Journal of Genetics* upon its establishment in 1910, Salaman was also their first author to write on human genetics, on a Mendelian view of Jewish heredity. Through claims to this kind of expertise over heredity and breeding – claims which were by no means exclusive to geneticists - the potato was remade as a newly technical object.

According to Salaman, he first contacted William Bateson around 1905 after a couple of years convalescing in Barley, 30 miles or so from Cambridge.[28] Initially Bateson recommended he use animals for breeding and genetic study, including mice, guinea-pigs, and double-combed fowls, before eventually Salaman approached his own gardener "a man of stately mien who, looking down on me from his 6 ft. 2 ins. said that if a gentleman in my position *must* use his spare time in playing about with vegetables, he would advise the POTATO". Some of his surviving breeding notebooks are available for 1910 onward. By putting these records in dialogue with stocks of potatoes grown at his house and in field sites across England, Scotland, and Ireland, circulating these potatoes amongst those in the know, Salaman built his reputation as a potato expert.

Rather than moving towards any particular potato end it seems Salaman simply focused on the systematic production of novelty, perpetuating anything unusual that appeared in his garden, and selecting multiple plants for cross breeding. Of this work the most well-known result is his discovery of potatoes resistant to blight.[29] Aspects of his method are encapsulated in Figure 9.2, including the dependence on potato varieties acquired from countries around the world, as seen in the 'Congo' potato included at bottom right. This is just one example of many dozens of photographs that are affixed to the pages of his notebooks, photographs which also provide an example of Agar's 6th and 7th tech-enviro forms in combination (Chapter 1). Photographs allowed Salaman to switch back and forth between the tabulated information about individual plants and the tubers they produced over time. In the tables he records their names, such as H19 (pictured near the centre of Figure 9.2), alongside the colour tuber produced (red, white, black), shape (long or round) and the number of eyes found on it. These are precisely the kinds of characters that were being investigated by eager Mendelians around the world at this time, and we can see evidence of Salaman thinking through his productions in Mendelian terms as he evaluates them. Against H24, for example, he records the shape as round but places a question mark

alongside it, noting “Shapes are fairly close rounds but not typical. The no. of eyes is against round.” Here ‘against’ meant that the high number of eyes (in this case 11) would suggest the hereditary unit characters were those of something other than a round variety. He is playing with the notion that a high number of eyes is correlated with long shaped tubers.

Over the years the extent of his variation making and the complexity of his crosses expanded. He also sought out opportunities to share his productions with interested parties, including owners of farming estates, such as Walter Wooll West of Needham Hall, Wisbech, and proprietors of the UK’s most influential seed businesses, such as Martin Sutton of Suttons Seeds, alongwith official representatives of state managed trialling stations, such as M. Caffrey of the Cereal Station in Ballinacurra, Ireland. Remarkably, given the relationship between trialling and convalescence described earlier at the Ormskirk workhouse, a second though vastly more lavish medical site played an important role in Salaman’s own work. Presumably thanks to connections made through his medical training, Salaman had convinced Dr Charles Easterbrook, Physician Superintendent at the Crichton Royal Institution in Dumfries, to grow on stocks of his varieties in Scotland. The Crichton was a world famous asylum for lunacy, run according to new principles described by medical historians as “moral treatment, under medical control”, with large gardens and considerable air.[30] Salaman had around 300 distinct varieties grown on and under observation at the Crichton, making that hospital a resource of considerable importance. Through places like the Ormskirk workhouse and the Crichton Royal our account of plant technologies bolsters themes covered elsewhere in this volume while drawing in starkly different social contexts. The differences between these contexts will come to matter in section three.

A quick look at Salaman’s correspondence reveals how he circulated potato crosses amongst influential agriculturalists, potatoes which were named and organised according to his own record keeping schemes, at the same time retaining control (or at least asserting control) over the uses to which they could be put. In this respect his technical knowledge of the plant was at one and the same time a means of establishing intellectual property, and organising social relations.[31] In a letter to Sutton he writes:

> I think on the whole, the plan you suggest would be best, that I should let you have 7lbs of each of the varieties to test and then, if you think anything of any of them

> you will be able to say so and offer a price next year. At the same time they will be grown in Scotland under measured conditions, and I shall, of course, naturally retain the right of showing them to anybody else.[32]

If we look at the list of materials that Salaman then arranged to have sent to Sutton, these included the products of crosses such as 'M5B32 x fb2', 'H2 x ER2', and 'M5B18 x Wat.24'.[33] Even if Salaman had sent his complete records it would have been a job of work to understand what any of these crosses meant or the varieties from which they descended. Throughout the 1910s he continued to organise and manage these disparate stocks by letter, all the while becoming ever more embroiled in war work, initially as a medical officer signing off men as fit to fight before eventually joining the Royal Army Medical Corps. In 1917 he wrote to West of Wisbech that the varieties then being sent to him "are the result of eleven years experimental breeding during which time I have raised well over a quarter of a million seedlings."[34] Of course not all of these seedlings had been raised by Salaman directly, he had had considerable help from Will at the Crichton, and his own assistants at home.

Either side of the Great War, which had placed increased significance on domestic agricultural production, the credit that Salaman and other geneticists like him had accrued through their research and promises of agricultural improvement were rewarded with an expansion of funds available for the institutionalisation of agricultural science and genetics, primarily accomplished through grants from the Development Commission (DC).[35] This brings us to the other three persons highlighted in the Ormskirk show photograph: Parker, Bryan and Whitehead.

All were stood together with Salaman thanks to their being involved with Cambridge based agricultural botany: Salaman through his early work with Cambridge University geneticists and eventually, from 1927, as Director of the Potato Virus Research Station established in Cambridge on DC funds; Wilfred H. Parker as the first Director of the National Institute of Agricultural Botany (NIAB), established in 1919 in Cambridge on DC funds; Harold Bryan, the Superintendent who took over from John Snell when the Ormskirk trials were taken over by NIAB in 1919 resulting in the establishment of the Ormskirk Potato Testing Station; and Nora Whitehead, assistant to Bryan at Ormskirk and a significant potato

authority who would later author (amongst other things) the widely used and repeatedly reprinted *Key for the identification of commercial potato varieties and rogues in the field*.[36] It is important to stress how significant the initial research and commercial trialling begun at Ormskirk had been in gathering support for such nationally funded agricultural science institutes in the first place. What I argued and explained above for Salaman can be extrapolated and expanded many times over for the collective community of breeders (some Mendelian, many not), who each through the manipulation, analysis, circulation, and sale of plants had built a number of different overlapping communities of expertise, each ostensibly dedicated to plant improvement.[37] Recognising how linked their expertise was to control of physical plant material is one result of exploring plants as technical artefacts embodying knowledge. If one were to trace the working practices of persons such as Bryan, who died shortly before the Potato Testing Station was closed in 1940, or even more importantly that of Whitehead, one of a number of women who made successful scientific careers through agricultural plants, we would get a sense of how and in what ways the understanding and management of the British environment has developed in techno-environmentalist mode.[38]

Section three: Potato culture

Having established the range of persons and interests in the potato, both as a means of governance and as a technical artefact, this section turns to demonstrate that being a technology does not place an object outside of society and culture. Again, this will not come as a surprise to historians of technology, though few of them have extended their arguments thus far to encompass biological things (see my footnote 6 for a list of exceptions). The work of Barbara Hahn in *Making Tobacco Bright* is an important exception, explaining how different kinds of production methods, and different kinds of division of labour throughout tobacco growing, harvesting, preparing, packaging and trading - often depending on the use of different kinds of technology and technique - were constitutive of the plant product. Different kinds of society and culture are made through and with tobacco plants and potatoes, just as commodity historians might focus on how different kinds of

tobacco plants and potatoes make up societies and cultures. We have already glimpsed this with regard to people being fined for not growing correct potatoes, making them criminals, and people building analytical schemes and reference systems around the potato, making them experts. This can all be brought together by attending to the relations between our two most important sites, Ormskirk and Cambridge, and the societies and cultures of breeding that they represented.

From the outset Ormskirk was considered a problematic kind of research site by geneticists in Cambridge, including Rowland Biffen of the PBI, Salaman, and towards the end of the interwar period, even its new owner NIAB. In part these complaints were about geographies of power, and the desire to have as much as possible centralised around the various different headquarters in Cambridge. In addition, Ormskirk was not considered the most sophisticated research site (it was equipped only with an 'Elsan closet' toilet that was not replaced until the 1960s).[39] Most importantly, complaints were also about how potato breeding should be organised, according to whose expertise, and on what principles the potato growing industry should be taken forward. In pulling this story together it becomes impossible to distinguish between when the potato is technology, environment, or culture.

The earliest evidence that not all was well with relations between Cambridge and Ormskirk comes from a letter from Rowland Biffen to Lawrence Weaver, two people central to the founding of NIAB.[40] Biffen mentions "I must manage Ormskirk somehow or other this time - if only to carry wart disease spores back on my boots & so start a fresh centre here."[41] Where this is said in passing, much more pointed was Salaman in a letter to Sutton, explaining that he finds the role played by the Ormskirk to be galling.

> I will certainly keep H2 x E2 B2 for a fortnight till you come back and I don't want to deal with the man I spoke to you of till I know who he is. If I seemed to be disappointed it really is not so much that, as I felt a little irritated about this seedling. I do not think there is any doubt - and it was the general opinion at Ormskirk that it is probably one of the very best Earlies that have ever been seen, it has been going nine years now, not only you have seen it but Matthew Wallace and heaps of practical people have seen it in Scotland year after year, said it is nice, etc. and it is only when it receives official recognition at Ormskirk and is incidentally declared to

> be susceptible, that its real virtues are recognised. As a mere scientific worker I recognised its merits seven or eight years ago.[42]

In Salaman's own self representation there is a clear distinction between scientific work and whatever goes on at Ormskirk, with implications for the who and how of potato assessment. Ormskirk coming under the operation of NIAB in 1919 did not necessarily settle Salaman's difficult relations with the rest of the trade as represented here, or indeed with NIAB's own enterprises, as the following two episodes reveal.

One of the first challenges that Salaman set himself once he had the full resources of NIAB at his disposal was what he considered to be the problem of synonyms. As much as it may have perplexed the likes of Salaman, the problem of synonymity has been of considerable use to historians. Synonymity is the identifying or selling of a plant of one variety under the name of another variety. The practice was common and represents aspects of a culture of innovation that recognised multiple ways in which value could be added, often collectively, to a variety.[43] For Salaman though, the problem of synonymity was an ideal way in which to assert his status as a potato identifying centre of power, and also the primacy of a genetic interpretation of plants. Establishing the Potato Synonym Committee at NIAB, Salaman set about creating the infrastructure for the annual assessment of potato varieties and their comparison to one another, to determine (at least to his own satisfaction) when a novel variety sent to NIAB was truly novel and when it was simply the same as another. While no legislation followed to intervene, Salaman did arrange for the state funded and *National* Institute of Agricultural Botany to circulate notices in national newspapers when seed traders and breeders were stocking what his Committee had declared to be a synonym. These activities were not received well by established growers, the evidence for which is both remarkable and enjoyable.

In a series of articles and letters sent to the *Nurseryman and Seedsman* correspondents and authors complained, got angry, and mocked Salaman for his intervention on behalf of true potatoes. Their displeasure became acute following the 1922 Ormskirk show, when Salaman was given the podium. "It is all very well for Mr. R.N. Salaman, J.P., M.D., to get up on his legs at Ormskirk" wrote the author of the *Nurseryman* 'By the Way' segment "and lecture the seed trade upon its "deplorable and dishonest

practices," but if he were in the seed trade and not in the medical profession, he would very probably sing quite a different song."[44] In the following issue another author, W. Cuthbertson, lamented how Salaman's whole approach undermined the cooperative foundations of Ormskirk. He reminded readers that it was traders and farmers who began the early trials with John Snell, which when later taken over by NIAB, continued to be assisted by the trade who leant the Station their finest potato experts.[45] In the next issue Salaman had a poem dedicated to him, 'Do tell', which made fun of his performance at Ormskirk and ended by again stressing his merely medical credentials. The culmination though came in the Christmas issue, in the form of a one act play titled 'Synonyms'. In the play a gardener, Will Orange, is down the pub boasting about his line of work and his knowledge of potatoes. After a little back and forth about synonyms, his companions, the grocer, landlord, butcher, and tailor, entice him to explain:

> "A Potato is a Potato, and a synonym is another one morpho-, er- wait a bit while I look that up. Yes, here it is - morphologically and physiologically identical with it. That's what a synonym is, and as nearly everybody grows synonyms, it stands to reason that they are much cheaper than the real thing."
> "But how do you know which is the real thing?" said Harry.
> "Ah! That's where art comes in. It's an art that's a cut above the ordinary - in fact, I would venture to say there are only two people who can speak with authority on the subject. One's a celebrated London doctor, and the other's myself. The doctor's made a lifelong study of Potatoes, and he knows so much more about them than any-body else, that there's nobody can tell him when he's right or wrong. Consequently he's always right."
> "And how about yourself?" said Dicky.
> "Well, I know so much more about the subject than anybody else in this locality, that what I says here abouts 'goes' too. See!" responded Will.[46]

These sources evidence an internally coherent society of breeding with its own standards of best practice and expectations as to what kind of relationship with fellow breeders and traders is necessary in order to imbue a person or institution with authority. They also

capture that these arrangements as they had been understood were new becoming subject to change. This play even evidences the remaking of national or localised centres of authority, as between 'London' and what 'goes' in any given place. Lastly, their incredulity at how one could even tell the difference between potatoes that look the same in every respect (beyond the skills of any normally trained farmer or breeder), also highlights the importance of the technical component of the argument being made by geneticists. Salaman, approaching the issue of synonyms away from the kinds of society that invested in Ormskirk, and working from the perspective of the new Mendelians based in Cambridge, had intruded upon that culture on behalf of his own potato technologies and culture.

Lest potato identification and assessment be taken as too classic an example of an emerging rational modernity imposing itself on a pre-existing 'natural' order, my final example demonstrates that Salaman did, on at least one occasion, also throw over that same rationalising process either out of carelessness, or in pursuit of an even larger demonstration of his authority and technical skill, or perhaps out of ignorance of the social aspects of technical knowledge. At some time during the early years of the first Ormskirk trials, while John Snell was still involved in their coordination, the Lord Derby Gold Medal competition was begun. Awarding of the Medal became part of the annual show. It was organised by a local committee of breeders and farmers, though eventually also became the responsibility of NIAB. In 1928 Salaman caused a major embarrassment. That year the Gold Medal Committee decided to award the medal to '520', a variety bred by Donald MacKelvie, famed breeder of the Arran varieties. Unbeknownst to the rest of the Committee (of which Salaman was a member), Salaman had a few weeks earlier written to MacKelvie telling him to drop the variety. On hearing about Salaman's letter Bryan wrote to NIAB's secretary F.C. Hawkes. "To my mind it is an incredible happening" Bryan wrote. "Salaman is a member of the Gold Medal Committee, he is Chairman of the Committee responsible for the Institute's potato work and he is also Chairman of the Institute itself: you may therefore imagine the importance MacKelvie attaches to any letters from Salaman." It was not only, or even mainly, Salaman's authority that agitated Bryan, rather how it all looked to MacKelvie whom he called "The most important man in potato world". He closed his letter by stating:

> The reputation of the Institute, even for sanity, and the future conduct of the trials are surely involved. In view of the gravity (unless my judgement is completely at fault) of this note, I should be very glad to know what Parker [NIAB Director] intends to do as soon as possible. If the award goes through, then MacKelvie must have some explanation of the extraordinary position...The more I think of this the more mad it seems. The Gold Medal Committee bestow on 520 a Gold Medal for outstanding merit, and the Chairman of the Institute's Potato Committee advises the owner to scrap it.[47]

Technical knowledge has to be *shown* to work, and is shown to work through social organisation. Bryan feared a collapse. Salaman's potatoes were very different from MacKelvie's, circulating in two very different social worlds, each producing different kinds of agricultural governance (Salaman's more technocratic and individualist, as seen in the newspaper notices shaming synonym growers, MacKelvie's and other breeders more voluntarist and communal), and different kinds of expertise. Salaman and other geneticist breeders were also different from the rest of 'potato world' thanks to their broader biological interests. Salaman did, for instance, consider knowledge of potato heredity as of a piece with human heredity in ways that commercial breeders might have speculated on but rarely turned into the subject of writing. Recognising this offers one final insight as to how analysis of plants as technologies helps produce histories of the techno-environment.

As with the majority of the first geneticists, Salaman saw in genetics answers to societal problems well beyond the agricultural. As I have explored elsewhere, emergent views of heredity in the early twentieth century sat extremely comfortably with - and fed off of - a range of other goals and values, whether they be in architecture, design, industrial manufacture, or public health.[48] Eugenics was part and parcel of British culture and in this much Salaman was no different, giving talks on the subjects of eugenics and public health and writing for publications such as the *Eugenics Review*. This observation is worth including so that we know such themes will permeate histories of British environmental change, either through policy and governance, through the biological objects that make up the environment and industry, or through social worlds of agriculture and environmental management, right up to the present day.

Conclusion

I bring this chapter to a close with a passage that brings us full circle to the argument that plants are technologies. While farmers and breeders had had to make do with the pages of *Gardeners' Chronicle*, in 1930 Salaman was given the full weight of the BBC. Broadcast on the 14th of January, radio listeners heard some of the earliest material from what would later become his full-length historical treatment of the potato, here titled 'The History and Economic Influence of the Potato'.

> The chipped flint, the potters sherd, the invaluable evidence of mass progress before the days of the sculptured stone or the inscribed word, are not the only records of our ancestor's victory over their environment. Man has stamped the impress of his genius no less on the living than on the inanimate. The records are scanty, the gaps therein are many and great, but the end results - the bending of the plant and animal world to his own uses - are the outstanding achievement of prehistoric man.[49]

This is by no means the earliest example of this kind of statement, though it is doubtless amongst the first to be broadcast on the BBC. It has contributed to a formula of representation and understanding that is today widespread and seemingly inescapable. How much of the meaning of his talk as understood by his audience in 1930 would match that of audiences today? Is it disquieting that scientists and other experts have been saying much the same thing for nearly a century? Does bending nature to man's will, making biology into a technology, carry all that much significance in and of itself? Instead of allowing the suggestion of parity between the animate and inanimate to shock, excite, or perplex us, perhaps we should shrug off claims to novelty and control, and get on with negotiating who, when, and why of potato growing. From a study of Salaman's career we can at least recognise that the extent of any bending of plants and animals to human will has always first and foremost required the bending of persons.

There are many ways that one might tell environmental history, and ways in which environments can be historicised with and through technology. In this chapter I have addressed the techno-environments of spore filled fields in Ormskirk, well recorded gardens in Barley, and of circulating potatoes themselves. Breaking out of analytical tropes regarding the natural historical and the synthetic, the biological and technological, does not have to be done in response to contemporary biological engineering, though I have written this chapter with such an audience directly in mind. Here I have attempted to provide part of the platform for new techno-environmental histories of Britain in the form of suggestions and recommendations regarding how to conceptualise organisms in fields, streams, forests, and the air, by refusing to look for only certain kinds of qualities in plants and animals and other kinds of qualities in fences, bridges, paths, and pylons.[50] All of the unparseable organic and technological are full to the brim with social and cultural meaning, the sum total of which will make up techno-environmental history.

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Figure 9.1: Ormskirk show organisers, 1920

Caption

Group photograph of the Ormskirk show organisers for the year 1920, published in *The Preston Guardian* 30/10/1920. Reproduced by kind permission of the Syndics of Cambridge University Library. Salaman Archive MS Add.8171 Box 18. Some of those identified include - Front row, seated (left to right): Messrs J. Wood, Chief Inspector of Scottish Board of Agriculture (Ormskirk judge), and S.T. Rosbotham, J.P., C.C. (Chairman of the Ormskirk Potato Society), Sir Arthur Griffith Boscawen, M.P., Parliamentary Secretary of the Ministry of Agriculture, Alderman W. Fitzherbert-Brockholmes, C.B.E. (chairman of the Lancashire Agricultural Committee and the Lancashire and South Westmorland Farmers' Association), and Mr. F.J. Chittenden, director of the Royal Horticultural Society's Gardens, Wisley (Ormskirk judge). Back Row, standing (left to right): Miss N. Whitehead (hon. show secretary), Messrs H. Bryan, B.Sc., director of the Ministry of agriculture's immunity trials; W. Parker, director of the National Institute of Agricultural Botany, Dr. Salaman, M.D., W. Cuthbertson, J.P. (Messrs. Dobbie & Co.), A.C. Cole, general inspector in charge of the exhibition department.

Figure 9.2: Example of potato experiment photograph from Salaman's 1910 notebook

Caption

Photograph taken of potatoes grown by Salaman in his genetical research. Reproduced by kind permission of the Syndics of Cambridge University Library, and thanks to Jane Miller and Nina Wedderburn for agreeing copyright permissions for its publication. MS Add 8171 - Folders and Volumes 1, brown folder 'Potato Harvest 1910'.

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[2] Martin Reuss, "Afterword" in *The Illusory Boundary: Environment and technology in history*, ed. Martin Reuss and Stephen H. Sutcliffe (Charlottesville and London: University of Virginia Press, 2010), 298.

[3] Are animals technology?" – archive of messages posted on Envirotech, Envirotech@lists.Stanford.EDU, 2001. http://envirotechweb.org/wp-content/uploads/2007/05/animaltech.pdf [accessed 16/8/2017].

[4] Though not addressing organic material directly, Timothy Mitchell's formulation of agency in relation to environmental features such as the Aswan Dam have greatly influenced the work presented here. Timothy Mitchell, *Rule of Experts: Egypt, techno-politics, modernity* (Berkeley and Los Angeles: University of California Press, 2002). My sincere thanks to Deborah Scott for recommending Mitchell to me.

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[8] In referring to these as 'nature's technologies' I am inspired by the category of 'nature's experiment' as defined and developed by Mary Morgan, 'Nature's experiments and natural experiments in the social sciences', *Philosophy of the Social Sciences* 43:3 (2013).

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[12] My thanks to Mat Paskins for drawing this implication out in a discussion of how our chapters relate.

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[14] *Journal of the Board of Agriculture*, Sept (1894), 25-28, 14-16, 54.

[15] *Journal of the Board of Agriculture*, Dec (1898), 354-357. A set of potato seed is 'cut' when, as one might guess, the seed is cut and planted as two or more independent seeds.

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[30] Michael A. Finn, *The West Riding Lunatic Asylum and the making of the modern brain sciences in the nineteenth century* (PhD diss., University of Leeds, 2012), 42.

[31] Christine MacLeod and Gregory Radick, "Claiming ownership in the technosciences: Patents, priority and productivity*," Studies in History and Philosophy of Science Part A* 44:2 (2013); Berris Charnley and Gregory Radick, "Intellectual property, plant breeding and the making of Mendelian genetics," *Studies in History and Philosophy of Science Part A* 44 (2013).

[32] Letter to Martin H. Sutton from R.N. Salaman, 9/11/1914. M.S. Add. 8171, Box 3. University Library, University of Cambridge.

[33] Letter to Will (gardener at the Crichton) from R.N. Salaman, 10/11/2014. M.S. Add 8171, Box 3. University Library, University of Cambridge.

[34] Letter to Walter Wooll West from R.N. Salaman, 13/3/1917. M.S. Add. 8171, Box 3. University Library, University of Cambridge.

[35] Robert Olby, "Social imperialism and state support for agricultural research in Edwardian Britain," *Annals of Science* 48 (1991). For a recent account unpacking the history of UK genetics in terms of its role in the governance of agriculture see Berris Charnley, "Geneticists on the farm: agriculture and the all-English loaf", in *Scientific governance in Britain, 1914-79*, eds. Don Legget and Charlotte Sleigh (Manchester: Manchester University Press, 2016).

[36] After marriage Nora McDermott. McDermott (1948).

[37] For a recent survey of the historiography of genetics in agricultural plant breeding, demonstrating the breadth of responses to Mendelism and the bounds placed on its usefulness for breeding, see Jonathan Harwood, "Did Mendelism transform plant breeding? Genetic theory and breeding practice, 1900-1945," in *New perspectives on the history of life sciences and agriculture*, eds. Denise Phillips and Sharon Kingsland (Heidelberg, New York, Dordrecht, London: Springer, 2015).

[38] Another excellent case that should be pursued is that of Mary D. Glynne, M.Sc, who while working at Rothamsted Experimental Station developed tests for susceptibility to wart that could be conducted indoors rather than relying on a field space. Mary D. Glynne, "Infection experiments with wart diseases of potatoes. *Synchytrium Endobioticum* (Schilb) Perc." *Annals of Applied Biology* 12:1

(1924). Her 'pot experiment' was soon adapted by McDermott at Ormskirk, though reported on by Bryan who records his thanks to McDermott as being "largely responsible for the technique employed". Harold Bryan, "Wart disease infection tests," *The Journal of Agricultural Science* 18:3 (1928). On women and scientific career in genetics see Marsha Richmond, "Women in the Early History of Genetics: William Bateson and the Newnham College Mendelians, 1900-1910," *Isis* 92 (2001).

[39] Minutes of 164th meeting of the Executive Committee 14/6/63. E - 5.9. NIAB Archive, Huntingdon Road, Cambridge.

[40] The founding and first fifty years of NIAB's history are the subject of Dominic J. Berry, *Genetics, Statistics, and Regulation at the National Institute of Agricultural Botany 1919-1969* (PhD diss., University of Leeds, 2014 a). Much greater attention to the role of Rowland Biffen in the growth of UK genetics more broadly can be found in Berris Charnley, *Agricultural Science, Plant Breeding and the Emergence of a Mendelian System in Britain, 1880-1930* (PhD diss., University of Leeds, 2011); Berris Charnley, "Experiments in empire-building: Mendelian genetics as a national, imperial, and global agricultural enterprise," *Studies in History and Philosophy of Science Part A* 44:2 (2013). The later years of NIAB from 1970 onwards are the subject of Matthew Holme's thesis, see his Chapter 8 in this volume).

[41] Letter from R.H. Biffen to R.N. Salaman, 11/10/1918. C-5.10 Donations and Subscriptions 1917-1921. NIAB Archive, Huntingdon Road, Cambridge.

[42] Letter to Martin H. Sutton from R.N. Salaman, 25/8/1919. M.S. Add 8171, Box 3. University Library, University of Cambridge.

[43] Dominic J. Berry, "The plant breeding industry after pure line theory: Lessons from the National Institute of Agricultural Botany," *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 46 (2014 b).

[44] Anon, "By the way," *Nurseryman and Seedsman* Nov 16 (1922 a), 23.

[45] W. Cuthbertson, *Nurseryman and Seedsman*, Nov 23 (1922), 25.

[46] Anon, "Synonyms," *Nurseryman and Seedsman* Dec 21 (1922 b), 27.

[47] I am deeply grateful to Tricia Cullimore for finding this letter during her own archival research and passing it on to me. I unfortunately cannot confirm the location of the letter in this archive. From its contents it would likely be included in T-3.19, Potato Committee Papers and Ormskirk Committee Papers, NIAB archive, Huntingdon Road, Cambridge. A PDF can be supplied.

[48] Dominic J. Berry, "Agricultural Modernity as a Product of the Great War: The Founding of the Official Seed Testing Station for England and Wales, 1917–1921," *War & Society* 34:2 (2015).

[49] 'The History and Economic Influence of the Potato'. M.S. Add 8171 Box 13. University Library, University of Cambridge.

[50] My reference to pylons here picks up on a line of research undertaken by the historian and literary theorist James Purdon, who has looked at artistic responses to the arrival of the electricity network across Britain in the interwar period. Thus far he has only published a small section of this research: James Purdon, "Landscapes of power," *Apollo Magazine*, 21 Dec (2012) https://web.archive.org/web/20130121141715/http://www.apollo-magazine.com/features/7920953/landscapes-of-power.thtml [accessed 5/4/2017]. James Purdon, "Electric cinema, pylon poetry," *Amodern*, October (2013).