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A matter of where and when—the appearance of Late Blight of potato in Australia

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ABSTRACT

Late Blight, also called Irish blight and brown rot, devastated potato crops in Ireland and countries in Europe in the 1840s, and led to famines, deaths, and the emigration of tens of thousands of poor farmworkers. The outbreaks were blamed on many factors, but finally it was demonstrated that the causal agent was an oomycete (water mould) *Phytophthora infestans*. The Queensland Government Entomologist and Vegetable Pathologist, Henry Tryon, claimed that he made the first discovery of Late Blight in Australia, on leaves and tubers of potato collected in May 1909 around Brisbane. Within three months, the disease was found in all Australian states. Tryon believed that the Queensland outbreak was caused by *Phytophthora*-infected planting tubers obtained from Tasmania, which growers and the government in that state initially refused to acknowledge. The Victorian Vegetable Pathologist, Daniel McAlpine, initially agreed with the Tasmanians, but later admitted that he had identified *Ph. infestans* in Tasmanian potato crops. A herbarium specimen of potato leaves collected in 1900 in Victoria, examined over a century later, was found to be infected with *Phytophthora infestans*. All the ruckus that ensued after Tryon's discovery was unnecessary; it was really a matter of where and when.

Keywords: Daniel McAlpine, Henry Tryon, Irish blight, Late Blight, murrain, *Phytophthora infestans*, plant pathology, potato.

Introduction

The historical and biological impacts of the 'murrain' that devastated the Irish potato (*Solanum tuberosum*) crops in 1845, 1846 and 1848 have been discussed by many authors.[1] The disease, variously named Irish blight, potato blight, Late Blight and brown rust,[2] was first discovered in the eastern United States of America (USA) in 1843, from where it spread to Belgium and other European countries in 1845.[3] The western part of South America is the original source of the oldest genotype (FAM-1) of the causal agent, the oomycete (water mould) *Phytophthora infestans*, from where it was probably transported in infected tubers to the USA.[4] Australia and New Zealand either avoided introduction of the disease until the 1890s (1893 in New Zealand) or the pathogen was introduced earlier but not identified. In this paper we discuss suspected reports of Late Blight in Australia in the nineteenth century, and the claim of its first authenticated report by Queensland government Entomologist and Vegetable Pathologist Henry Tryon (1856–1943). We outline the controversy and bitterness between officials in Tasmania and in the Australian mainland states over the cause of a 'brown rust' that was prevalent in the northwestern potato growing regions of Tasmania in the 1900s. Finally, the reasons for Tryon's reactions to the protracted confirmation of his diagnosis by Vegetable Pathologist of Victoria, Daniel McAlpine (1849–1932), are discussed.

[1] Pink (1879) pp. 52–54. Kinealy (1990). Braa (1997). Large (2003*a*, 2003*b*).
[2] Tryon (1909*a*) p. 118.
[3] Saville and Ristaino (2021) p. 1.
[4] Saville and Ristaino (2021) pp. 2–8.

The discovery of the causal agent of Late Blight

In Europe and England theories about the cause of the Late Blight abounded after the disease decimated potato crops in Europe in the 1840s, and included microscopic insects, 'atmospheric influences' such as poisons and 'electricity' in the air, the use of potato tubers from the same stock for planting, and animal manuring.[5] Others, however believed that the disease was caused by a fungus.

In a letter written on 14 August 1845 and published in the *Gazette de Liege* five days later, Belgian amateur mycologist Marie-Anne Libert (1782–1865) stated that she believed the disease was caused by a fungus, *Botrytis farinosa*.[6] Later Belgian clergyman and amateur mycologist Edouard van den Hecke wrote on 31 July 1845 that *Botrytis polysora* was the pathogen.[7] In her letter, Libert suggested that the fungus causing the murrain should be called *B. vastatrix* (which in Latin translates to destroyer or ravager). However, it was ultimately described, illustrated and named *Botrytis devastatrix* (the species name is a version of *dévastatrice*, the French word for devastator) in a paper written on 23 September 1845 by the Belgian mycologist Charles Jacques Edouard Morren (1833–1886).[8]

Unbeknown to Morren, French mycologist Jean Pierre François Camille Montagne (1784–1866) had described *Botrytis infestans* on plant tissue affected by Late Blight in a paper published earlier, on 3 September 1845.[9] Despite finding *B. infestans* in/on affected potato tissue, Montagne did not agree that the fungus was the cause of the disease. Rather, he, like many others believed that the presence of the fungus was the result of the disease.[10]

The taxonomy of the Late Blight pathogen proceeded for several decades along two streams; the 'infestans' stream, and the 'devastatrix' stream. In 1855, German botanist Johann Xavier Robert Caspary (1818–87) transferred *B. infestans* to the genus *Peronospora*, making the new combination *Peronospora infestans*.[11] Just a year later Caspary published the name *Peronospora devastatrix* whose six synonyms included *B. infestans* and *Pe. infestans*, but he gave no reason why he had persisted with the 'devastatrix' stream.[12]

Only the 'asexual' state (sporangiophores bearing sporangia in which the infective zoospores developed) (Fig. 1) of the pathogen was known at that time, but the search was on for the 'sexual' state (oogonia, each containing a single oospore). The history of that discovery has been well documented,[13] but in summary the finding of oogonia eluded even the most famous mycologists of the time, the Englishman Miles Joseph Berkeley (1803–88) and the German Heinrich Anton de Bary (1831–88).[14] In 1876, the latter scientist, believing that the potato fungus was not a species of *Peronospora* on the basis of its asexual morph, introduced the genus *Phytophthora* with *Ph. infestans* as the type species.[15]

It was not until 1910 that the oogonia of *Ph. infestans* were discovered by the American botanist George Perkins Clinton (1867–1937). He grew isolates of the pathogen on oat juice agar and other media and found that under certain conditions smooth-walled, pigmented oogonia, 34–50 μm in diameter, were formed, each enclosing a single, globose oospore developed in the agar of single 'pure' cultures.[16] Others, such the English mycologist and plant pathologist George Herbert Pethybridge (1871–1948) and Irish plant pathologist Paul Aloysius Murphy (1887–1938) also claimed that oogonia of *Ph. infestans* grew on modified oat juice agar from single cultures.[17] The oogonia illustrated by them are shown in Fig. 2.

The first (false) reports of Late Blight in Australia

In a 52-page chapter on the history, biology and management of Late Blight in *Handbook of Fungus Diseases of the Potato*, Daniel McAlpine (1849–1932) stated that the disease was recorded in New South Wales in 1846.[18] However, we consider that he was mistaken. McAlpine based his claim on a comment by Joseph Phipps Townsend (1813–1888): 'I observed in the local newspapers that the potato disease made its appearance in the colony in August 1846'.[19] Townsend did not identify 'the disease'. Our perusal of Australian newspapers in 1846 (Trove; https://trove.nla.gov.au) reveals only one article

[5]Berkeley (1846) p. 13–14. Pink (1879) pp. 55–56, 58.
[6]Libert (1845).
[7]Hecke van den (1845).
[8]Morren (1845).
[9]Anonymous (2023*a*).
[10]Duchartre (1845–1846) pp. 151–175. Berkeley (1846) p. 18.
[11]Anonymous (2023*b*).
[12]Caspary (1855) p. 325.
[13]Ristaino (1998).
[14]De Bary (1876) pp. 248–249.
[15]De Bary (1876) p. 240.
[16]Clinton (1910) p. 773.
[17]Pethybridge and Murphy (1913) p. 581.
[18]McAlpine (1911) p. 4.
[19]Townsend (1849) p. 16.

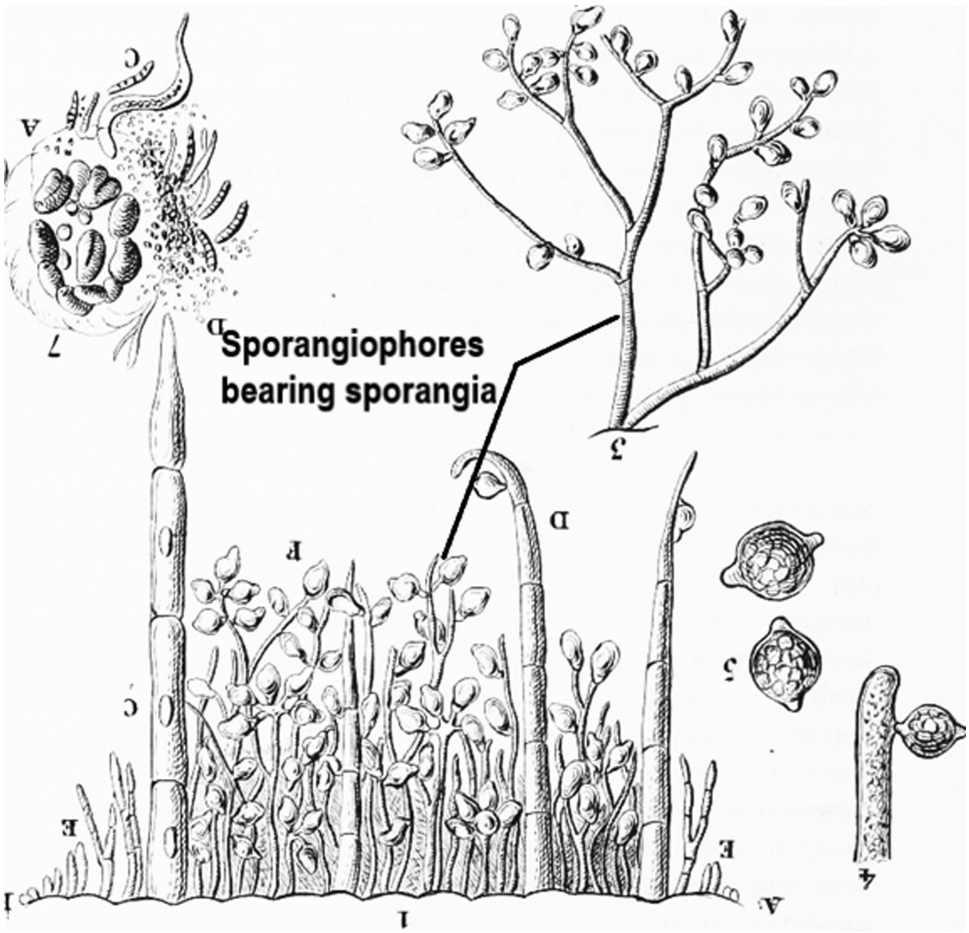

Fig. 1. Line drawings of the sporangiophores and sporangia of *Botrytis devastatrix* (as written, now *Ph. infestans*), Morren (1845) p. 287.

that specifically mentioned the disease in Ireland had been 'found' in the colony.[20]

This 1846 article stated that potato tubers seen at the Melbourne markets in May exhibited 'every symptom of the disease … as having destroyed the potatoe [as written] crop not only in Ireland and England, but also on the Continent'.[21] The symptoms and signs[22] are described as 'like measly [symptoms of measles] pork, and a fungus-like excresence [a distinct outgrowth] upon the surface'. These symptoms do not match those of Late Blight on tubers, namely a brown discolouration and later rotting of the tuber beginning at the surface and expanding inwards (Fig. 3).[23] It is possible that the damage was caused by the root knot nematode (eelworm) *Heterodora radicicola*.[24]

In the following year, there were reports that potato crops in the Mount Barker region of South Australia were suffering from the same affliction that was occurring in Ireland.[25] However, neither symptoms nor signs of infection by a pathogen were described. It was almost forty years before another report of the 'Irish potato disease' appeared in an Australian newspaper.

An article in the *Queenslander* of 9 October 1886 reported that James Pink (c. 1836–1923), head gardener at the Brisbane Botanic Gardens, was 'fully persuaded' that he had found *Pe. infestans* (as reported) on potato plants growing in his garden.[26] He had also seen the disease in previous years but did not describe any signs or symptoms. The reporter was more cautious than Pink, pointing out that

[20]Newspaper articles about this subject must be carefully read, because many originated in Europe especially England and Ireland, and were simply republished verbatim in Australian newspapers.
[21]Anonymous (1846).
[22]Symptoms are the observable changes in a plant part affected by a disease, such as, a leaf spot. Signs are the observable evidence of a pathogen, such as, fluffy mycelium of a fungal pathogen.
[23]Tryon (1909*a*) pp. 118–120. McAlpine (1911) p. 5.
[24]McAlpine (1911) pp. 70, 72. Persley and Stirling (2010) pp. 27–29.
[25]Anonymous (1847).
[26]Anonymous (1886).

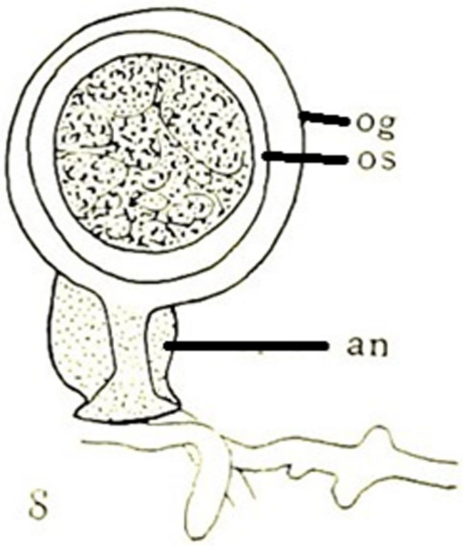

Fig. 2. Oogonium of *Ph. infestans*, og = oogonium, os = oospore, an = antheridium, part of plate XLVI (96), Pethybridge and Murphy (1913).

only microscopic examination could confirm the presence of the Late Blight pathogen. Pink's report proved to be false, because Frederick Manson Bailey (1827–1915), assistant curator at the Queensland Museum and later the Government Botanist of Queensland, sent specimens from Pink's affected potato plants to Berkeley and later also to mycologist Mordecai Cubitt Cooke (1825–1914) in England. Neither found *Pe. infestans* in the samples, but rather the saprophytic fungus *Epicoccum scabrum*. Bailey called the Queensland disease 'false potato disease'.[27]

In the late 1880s, a potato disease appeared in the Shoalhaven region of southern New South Wales, which some reporters stated was caused by *Pe. infestans* (as cited).[28] The symptoms described were: 'A white ring first appears, encircling the tuber about ½″ beneath the rim, which in a few days turns black, and rot begins at the eyes'. This description is indicative of infection caused by the bacterial wilt pathogen *Ralstonia solanacearum*.[29] In April 1894, Tryon had discovered bacterial wilt in potato crops growing in south-eastern Queensland.[30]

In December 1890, medical practitioner and biologist Professor Edward Shelton (1846–1928), who was employed by the Queensland Department of Agriculture as an agricultural instructor, stated he had visited several potato farms at

Fig. 3. Interior of potato tuber infected by *Phytophthora infestans*, plate 2 potato blight, McAlpine (1911).

Fig Tree Pocket near Brisbane and found 'the potato blight'.[31] Tryon disagreed. After visiting the affected crops and microscopically examining specimens, he did not find any evidence of *Ph. infestans*, instead observing 'Rabenhorst's *Macrosporium commune*' (the early blight fungal pathogen now known as *Alternaria solani*) and '*Fusisporium solani*' (now *Fusarium solani*).[32]

We conclude that the supposed outbreaks of Late Blight were, most likely, records of other maladies. There is no conclusive evidence that the disease was present in Australia in the nineteenth century, but available evidence suggests that it was in Australia by 1900. The oldest herbarium specimen of *Ph. infestans* in Australia was collected on potato plants near Kardella, Victoria, in 1900, by McAlpine's assistant Charles Clifton Brittlebank (1863–1945).[33] The pathogen, however, was not identified until 2001 by James Cunnington, former curator of the Victoria Plant Pathology Herbarium, who based his identification on morphology alone.[34]

The first authentic report of Late Blight in Australia

In 1909, Tryon claimed that his 'Office' was the first to discover the existence of *Ph. infestans* on potato crops in Australia,[35] that the same pathogen had been in Tasmania the year before, and that infected planting tubers (often called seed tubers) had been responsible for its spread to

[27]Bailey (1889) p. 186.
[28]Anonymous (1888).
[29]Tryon (1894) p. 2. Martin and other (2010) pp. 204–205.
[30]Tryon (1894) p. 2.
[31]Shelton (1890).
[32]Tryon (1890).
[33]The specimen is held at the Victorian Plant Pathology Herbarium (VPRI 206a).
[34]James Cunnington personal communication.
[35]Tryon (1909*b*) p. 3.

Fig. 4. Symptoms of infection by *Ph. infestans* on leaves of potato plants, image courtesy of Andre Drenth.

other states (Fig. 4).[36] The pathogen had been collected from an affected crop near Brisbane, Queensland on 19 May 1909 by Mr R. G. Wridgway, a stock officer in the Department of Agriculture who was responsible for inspecting livestock and crops on dairy farms.[37]

On the assumption that the outbreak was an isolated case, attempts were made to eradicate the pathogen by spraying the plants with a solution of iron sulfate and sulfuric acid to kill them rapidly, prohibiting the movement of tubers from the farm, and burning the plant residues.[38] This proved to be a forlorn hope. Within two days, other outbreaks were detected in adjoining crops approximately 25 miles north of the original farm, and subsequent investigations revealed that most potato crops in southeastern Queensland were affected by Late Blight to some extent.[39]

The emphasis changed from eradication to management, which included the use of clean planting tubers, destruction of infected plants and tubers and spraying crops with Bordeaux mixture.[40] This fungicide is a mixture of copper sulfate and hydrated lime dissolved in water, which was developed by the Frenchman Pierre-Marie-Alexis Millardet (1838–1902) to control outbreaks of downy mildew on grapes.[41] Tryon noted that in Queensland, the disease may not have previously been recognised by growers because although the leaves and stems displayed symptoms typical of Late Blight (called Irish blight at the time), the tubers on affected plants remained sound due to the 'absence of rainfall at the time'.[42] The presence of leaf spot caused by *Macrosporium solani* (now *Alternaria solani*) also contributed to the confusion.[43]

Within three months of the identification of Late Blight in Queensland potato crops, it had been confirmed in Tasmania, Victoria, South Australia, New South Wales, and Western Australia, in that order.[44] In South Australia, the earliest herbarium records of *Ph. infestans* on potato are in 1909 and in New South Wales the oldest record of *P. infestans* was on 1 May 1910 on tomato, but the locality and collector are unknown. The oldest herbarium record of the oomycete in Tasmania was in 1910.[45]

In reference to reports of outbreaks of Late Blight in Australian states between May and August 1909, McAlpine wrote that the disease was 'first discovered or announced in Queensland by the Government Entomologist and Vegetable Pathologist on 19 May 1909'.[46] Just why McAlpine did not mention Tryon in this statement, and why Tryon in turn had been so insistent on claiming the discovery for his office, will be discussed below.

Rumbles in Tasmania

Tryon provided compelling evidence that the source of the outbreak in Queensland was *Phytophthora*-infected planting tubers sourced from north-western parts of Tasmania in 1908 and used for the June–August (winter) 1908 planting in Queensland. Later, tubers from these crops were used as material for the Queensland summer (March) planting in 1909. Tryon surmised that as the summer-planted 1909 crop in Queensland was affected by Late Blight, the pathogen must have been in tubers that originated from Tasmania in mid-1908.[47]

Similarly, he believed that outbreaks of the disease in the Clarence River district of New South Wales in 1909 were the result of the use of Late Blight-infected planting tubers from Tasmania.[48] However, in March 1909, a Tasmanian

[36] Tryon (1909*b*) pp. 5–6.
[37] Tryon (1909*a*) p. 118.
[38] Tryon (1909*b*) p. 3.
[39] Tryon (1909*a*, p. 118, 1909*b*, p. 3)
[40] Tryon (1909*a*) pp. 123–127.
[41] Large (2003*c*) p. 225.
[42] Tryon (1909*b*) p. 4.
[43] Tryon (1909*b*) p. 4.
[44] McAlpine (1911) p. 5.
[45] The specimen is held at the Plant Pathology and Mycology Herbarium, NSW (DAR144).
[46] McAlpine (1911) p. 5.
[47] Tryon (1909*b*) p. 5.
[48] Tryon (1909*b*) p. 6.

newspaper reported that a Sydney seedsman had imported ten tons of 'seed potato' from London.[49] So, it cannot be ruled out entirely that some outbreaks of Late Blight in the Australian mainland states in 1909 were the result of planting *Phytophthora*-infected tubers from sources other than Tasmania.

The assumption that infected Tasmanian tubers were the most likely source of the outbreaks of Late Blight in Queensland was proven correct after Tryon microscopically examined tubers from forty five sacks of potato tubers sent from Tasmania via Sydney in June 1909, in which he detected the 'true potato blight'.[50] By September 1909, 107 consignments of potato tubers from Tasmania had been banned from entering Queensland. New South Wales (the largest importer of potatoes) also banned the importation of potato tubers in August 1909, but lifted the embargo a few months later.[51] The other Australian states followed Queensland's lead.

In fact, in 1908, the agricultural authorities in Tasmania knew of the existence of a potato disease they termed 'brown rust' in the northern part of the state (Fig. 4). In a newspaper article of 24 July 1908 a correspondent wrote that the disease had 'appeared suddenly and developed rapidly' in northwestern Tasmania and that Mr A. M. Lea, the Tasmanian government entomologist, had stated that 'it was not a serious one'.[52] However, after visiting potato farms in the Tasmanian northwest and inspecting diseased tubers, a New Zealand visitor familiar with Late Blight, was certain that *Ph. infestans* was the cause.[53]

In the following year, Lea and Mr T. A. Tabbart the Tasmanian Chief Inspector of Stock, visited that part of the state in late May 1908 to investigate a serious outbreak of 'brown rust' and concluded that it 'was a bacterial disease, known all over the world' (probably bacterial wilt caused by *Ralstonia solanacearum*).[54] Apparently, Lea changed his mind soon after, because in his report to the Tasmanian Minister for Agriculture, he stated any suggestions the disease was Late Blight were groundless; rather, the 'brown rust' was actually dry rot (caused by species of *Fusarium*).[55]

Mr J. H. Wilson of Davenport was not convinced that there was any disease in the northern Tasmanian potato crops. He wrote: 'The statements advanced by various persons interested in the potato industry as to the so-called potato disease … are ridiculous' and 'had created a scare to the detriment of the farming community'. In fact, he claimed, 'brown rust' was not a disease, rather it was caused by the weather—he urged growers to 'plod along' and take 'no notice of the scare'.[56] In 1908, Tasmanian authorities sent samples of 'brown rust'-affected tubers to a biologist in the New Zealand Department of Agriculture, Thomas William Kirk (1856–1936), who diagnosed the causal agent as *Fusarium oxysporum*. Late Blight had been detected in New Zealand in 1893 and 1904.[57]

McAlpine's mistake and Tryon's comments

At the request of the Tasmanian government, McAlpine visited northern Tasmania on 7 July 1909 and announced to a meeting of merchants that the diseased tubers recently sent to him were infected by *Rhizoctonia solani*.[58] Rhizoctonia rot is characterised by small black sclerotia on the surface of tubers and rotting of the tubers and stems.[59]

Because of Tryon's diagnosis, it did not take long for the Tasmanian newspapers to cry foul. One reporter complained of the embargo on Tasmanian potato tubers entering Sydney when McAlpine, the most eminent pathologist in Australia, had declared the disease in those tubers was not Late Blight. They also complained that a proposal by Queensland to allow tubers grown in New South Wales and Victoria into the state without inspection was blatant discrimination.[60] However, within a few months the disease was found in potato crops in all the states of Australia.

During his July trip to Tasmania, McAlpine collected samples from affected northwestern Tasmanian potato crops then transported them back to his laboratory for detailed examinations. Meanwhile, the potato disease issue became heated, with the parochial Tasmanian press rebuking Tryon for rushing to the conclusion that it was Late Blight. As Tryon stated: 'The dénouement (final outcome or part) was, however, soon to be brought about'.[61] On 4 August 1909, McAlpine reported to the Tasmanian Minister of Agriculture that the samples he collected were in fact infected by *Phytophthora infestans*. His findings were reported in the Tasmania press within a few days,[62] and even the *North Western Advocate and the Emu*

[49] Anonymous (1909*a*).
[50] Anonymous (1909*b*).
[51] Anonymous (1909*c*).
[52] Anonymous (1908*a*).
[53] Anonymous (1908*b*).
[54] Anonymous (1909*d*).
[55] Anonymous (1909*e*).
[56] Wilson (1909).
[57] Anonymous (1908*c*). Nicholls (1908).
[58] Anonymous (1909*f*).
[59] McAlpine (1911) pp. 60–64. Martin and other (2010) p. 216.
[60] Anonymous (1909*g*).
[61] Tryon (1909*b*) p. 7.
[62] Anonymous (1909*h*).

Bay Times had to admit the disease may have entered South Australia in Tasmanian tubers.[63]

Tryon did not hold back on this apparent backflip by his Victorian colleague. He implied that McAlpine should have accepted his initial diagnosis because he (Tryon) had 'special knowledge of *Phytophthora infestans*', and had seen (more likely, was aware of) the extensive distribution of Late Blight-affected tubers in different states. He also expressed surprise that McAlpine had taken four weeks to generate the distinctive reproductive structures of the oomycete (presumably sporangiophores and sporangia) when that could be achieved within 48 hours.[64] Tryon also wrote critically about the failure of legislation to prevent the introduction of Late Blight into Australia and later between states, particularly on the part of the Tasmanian authorities.[65] He called it 'a regrettable failure on the part of *Science* to act up to its high responsibilities in its relation to agriculture'.[66]

A decade before, in September 1897, the Queensland government, on Tryon's insistence, had enacted legislation banning the importation of potato tubers from all countries in which *Ph. infestans* had been recorded. Nine years later, at an intercolonial conference of government scientists, a resolution that followed Queensland legislation was passed by all states. However, Tasmania did not enforce the ban, and in 1907 and early 1908, consignments of tubers from overseas were being imported and used for planting material in that state. The evidence suggests that one or more of these consignments were the source(s) of the outbreak of Late Blight in the 1908 Tasmanian crop.

It is impossible to definitively prove the source of the original introduction of Late Blight into Tasmania and perhaps other states, but the United Kingdom, New Zealand, and North America are the main suspects. Tryon wrote that the Tasmanian authorities had been very concerned about the importation of potato tubers from both Ireland and Scotland in 1908, warning that 'there was a danger of the potato industry of the state being ruined'.[67] In January 1908 it was reported that the Tasmanian Minister for Agriculture would be investigating reports that 200 bags of potato tubers had been sent from Dunedin (New Zealand) to Tasmania and that he was concerned about the 'indirect danger of infection of potato blight'.[68] In the first decade of the twentieth century planting tubers were also being imported from California, USA.[69]

There is compelling evidence that the FAM-1 (the original) genotype of *Ph. infestans* (the only genotype present in Australia) was originally introduced from England,[70] but the possibility of this genotype entering via New Zealand cannot be discounted. McAlpine wrote that a minor outbreak of Late Blight on potato was reported from New Zealand in 1893, but it was misdiagnosed at the time as being caused by frost damage. However, when a serious and widespread outbreak of the disease occurred eleven years later (1904) it was soon realised that the previous outbreak had been caused by *Ph. infestans*.[71]

Despite Tryon's assertions that McAlpine and others had misdiagnosed the disease in tubers from Tasmania as being caused by *Fusarium* species and/or *Rhizoctonia solani*, it is quite possible that his (McAlpine's) diagnoses of samples sent to him were correct. Rhizoctonia rot was a relatively common potato tuber disease that by 1911 had been found in all Australian states,[72] and dry rot (also known as brown ring) caused by *F. solani* was not uncommon. McAlpine noted that *R. solani* and *Ph. infestans* could sometimes be found on the same tuber.[73]

Some answers to Tryon's reactions

Why did Tryon so vehemently defend his findings, and criticise his Victorian counterpart for an apparently erroneous diagnosis? The answer is twofold, in our opinion. Firstly, it can be said with some confidence that Tryon had a prickly personality. The Queensland government botanist, Cyril Tenison White (1890–1950), wrote that: 'He had a ready wit, though his remarks were frequently on the personal side and sarcastic enough to create for him some enemies.'[74] He also lacked tact. For example, many years earlier he had written an article for a Brisbane newspaper about the proposal by highly respected Government Botanist of Queensland, Frederick Manson Bailey, to write a supplement to the epic *Flora Australiensis* that had been published seven years earlier. In his opinion, Bailey was not the best person for the job, being a 'compiler' of names rather than a taxonomist like Ferdinand von Mueller, who had

[63] Anonymous (1909*i*).
[64] Tryon (1909*b*) p. 7.
[65] Tryon (1909*b*) pp. 4–5.
[66] Tryon (1909*b*) p. 5.
[67] Tryon (1909*b*) p. 5.
[68] Anonymous (1908*d*).
[69] 'Pecunia' (1906) p. 16.
[70] Saville and Ristaino (2021) p. 8.
[71] McAlpine (1910) p. 156.
[72] McAlpine (1911) p. 65.
[73] McAlpine (1911) p. 62.
[74] White (1945) p. 80.

played a major role in writing the first edition of the *Flora Australiensis* and whom he believed was a better choice.[75] It can only be wondered what effect that article had on their relationship, because they had been colleagues at the Queensland Museum and were both employees in the Queensland Department of Agriculture in 1893 and later in the Queensland Department of Agriculture and Stock.

The second train of events that probably influenced Tryon's pen was his association with brown rot of potato and the American bacteriologist Erwin Frink Smith. In 1894, Tryon described the symptoms of a disease of tubers that he had found in potato crops in southern Queensland.[76] The disease caused discolouration of the vascular tissue just under the surface of the tuber and later a soft, putrid rotting of the entire tuber, and was always associated with a bacterium that he named *Bacillus vascularum-solani*.[77] In early Australian plant pathological literature, the disease was often called 'Tryon's disease of potato'.[78]

American plant pathologist, Erwin Frink Smith (1854–1927), comprehensively described the symptoms and signs of the same disease in the USA (which he called brown rot),[79] and the morphology and physiology of the causal bacterium,[80] which he named *Pseudomonas solanacearum* (now *Ralstonia solanacearum*).[81] He was scathing of Tryon's earlier report and refused to accept that Tryon had actually discovered the disease, claiming that Tryon had neither provided clear cut evidence of the bacterium's pathogenicity, nor provided enough information on its physiological characteristics.[82] In his section of the *Queensland Department of Agriculture and Stock Annual Report for 1917*, Tryon complained about Smith's assertion in an unwieldly sentence: 'This suggestion is one that when the matter of rejecting the claims due to original discovery is the consideration is entertainable must be repudiated'.[83] It is plausible that Smith's criticisms had a long-lasting, profound impact on Tryon, who forcefully defended his observations and conclusions on the presence of Late Blight in Australia in 1909 and cast doubt on McAlpine's initial conclusions.

Late Blight in Australia post 1909

In some states, the losses due to Late Blight were severe. In Victoria, 50% of the potato crop was destroyed by the blight, while in Tasmania, the area planted to potato crops dropped from 35 159 acres (approximately 14 228 ha) in 1908–9 to 21 375 acres (approximately 8650 ha) in 1909–10,[84] a reduction of over 39%. In Queensland, Late Blight appeared again in the winter crop of 1910 and in more regions, but the losses were not as high as that of the first (winter crop) outbreak in 1909 due to the practice of spraying crops with Bordeaux mixture as well as unsuitable weather conditions for the development of the disease.[85] In 1910 and 1911, the pathogen neither spread nor caused significant losses,[86] but in 1913, 1914, 1915 and 1916 there were significant outbreaks in several regions of south east Queensland in Autumn-early winter.[87] From then on, outbreaks of Late Blight in Queensland were sporadic and of little consequence, and those that did occur were blamed on farmers who were 'generally ignorant of the ordinary preventative treatment'.[88]

In Queensland, special attention was paid to importations of potato tubers from the southern states by inspectors under the *Diseases in Plant Act*. For example, in the first half of 1911, 443 consignments of tubers (almost 20 000 bags) were found to be affected by a disease and, of these, 97% were affected by *P. infestans*.[89] The isolated outbreaks in Queensland were usually traced to the use of *Phytophthora*-infected seed tubers. In recent years, Late Blight of potato has not caused significant losses in Australia, with outbreaks being 'sporadic, localised and easily controlled'.[90]

Conclusions

The 'discovery' of Late Blight in Queensland by Henry Tryon in 1909 set in motion a chain of events that resulted in the exposure of personal and interstate rivalry. Tryon was scathing of the Tasmanian authorities who allowed the

[75]Tryon (1893).
[76]Tryon (1894, 1899).
[77]Tryon (1894, p. 3, 1899, pp. 57–59).
[78]Tryon (1899) p. 5.
[79]Smith (1896, pp. 11–12, 1914, pp. 175–178).
[80]Smith (1896, pp. 10–19, 1914, pp. 193–201).
[81]Smith (1896) p. 5.
[82]Smith (1914) pp. 207–208.
[83]Tryon (1917) p. 7.
[84]McAlpine (1911) p. 12.
[85]Tryon (1910) p. 8.
[86]Tryon (1911, p. 9, 1912, p. 9).
[87]Jarvis (1913) p. 99. Tryon (1914, p. 117, 1915, pp. 5–7).
[88]Tryon (1918) p. 6.
[89]Tryon (1911) p. 13.
[90]Burgess and other (2021) p. 160.

apparently uncontrolled importation of planting tubers from countries in which the Late Blight pathogen had been recorded, but there is evidence that other states did not fulfill that promises either. The failure of various experts in 1908 to identify *Ph. infestans* in Tasmanian tubers likely contributed to subsequent outbreaks of Late Blight in the mainland states, and unfortunately Daniel McAlpine took some months to verify Tryon's assertions that the pathogen was present in Tasmanian potato crops, and in planting tubers exported to the mainland.

It is apparent that Tasmanian authorities and particularly newspapers did not believe Tryon's initial diagnosis and mounted a vigorous and sometimes accusatory campaign of defence. That campaign was both personal towards Tryon and between governments for banning the importation of Tasmanian potatoes. For his part, Tryon wrote that he was surprised his Victorian counterpart Daniel McAlpine had taken so long to make the correct diagnosis, when it could be achieved in hours. There is no reason to believe that McAlpine had any vested interest in stalling his investigations; it is reasonable to assume that other factors had an impact on his ability to achieve that goal in a timely manner.

However, the identification, albeit in 2001, of *Ph. infestans* in a specimen of potato leaves collected in Victoria in 1900, raises uncertainty about the role that Tasmania played in the introduction of pathogen into Australia, and therefore in the Late Blight outbreaks on the Australian mainland states, including Queensland, that occurred from 1909 onwards. Perhaps some of the 'false' reports of Late Blight were true. Timely identification of that 1900 specimen soon after its collection may have changed the story.

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