

THE TOAD'S TALE

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Abstract

Recently uncovered documents reveal new insights into the introduction and release of the cane toad in Queensland in 1935; it was endorsed by leading international and Australian scientists, stridently supported by the sugar industry, promoted by the Premier of Queensland, and by the Prime Minister of Australia. Many prominent people thought that the introduction of the cane toad to Queensland's sugar cane fields was a good idea. With all this support, could it happen again today? Could another alien organism, championed by respected scientists, government departments and politicians, be released in Australia?

Keywords

Bufo marinus, cane toad, sugar cane, biological control, cane grubs



Figure 1 The cane toad. (Image courtesy of Mark Lewis)

Seventy five years after their release in north Queensland on the east coast of Australia, cane toads have covered more than 2,400 km across the top of tropical Australia and have crossed the West Australian border en route to the Kimberley Ranges in the far west of the continent.

How did this happen? Who started it? What could they have been thinking? I wanted to understand more about the people and the times, and I got lucky. The archive staff in BSES Limited – the successor to the Queensland Government's Bureau of Sugar Experiment Stations now owned by Australian sugarcane growers and millers – discovered some ancient and rusted files that had survived the Brisbane floods of 1974. Thanks to diligent public service record keeping, and the permission of BSES, there I found the chain of events I was looking for. The water-stained documents in faded musty manila folders revealed the story behind the cane toad's release in Queensland in 1935. It is a tale of biological control gone wrong. But what emerged was that it was endorsed by leading international and Australian scientists, stridently supported by the sugar industry, promoted by the Premier of Queensland, and even supported by the Prime Minister of Australia; many prominent people thought that the introduction of the cane toad to Queensland's sugar cane fields was a good idea.

For almost three hundred years the toad's tale has been written in the margins of colonial expansion and the sugar trade. In 1735 Carolus Linnaeus, the father of the systematic classification used universally by scientists, met a wealthy collector of natural curiosities, Albertus Seba, who had in his collection in Amsterdam a giant toad purchased from a sailor who brought it from Suriname; it was a by-product of the Dutch trade in slaves, sugar, coffee and the booty of piracy. Linnaeus included it in his *Systema Naturae* as *Rana marina*; it was later reclassified *Bufo marinus* – the marine toad. But Linnaeus did not have much regard for toads and their ilk; he reasoned their '... horrible cold bodies, filthy colour ... fierce faces, ponderous features ... raucous calls, squalid habitats, and dreadful venom' was the reason why '... the Creator had not made many of them'¹.

But the toad, variously called aguaquaquan, sapo grande, marine toad, giant American toad, great Mexican toad, South American toad, Central American toad, Suriname toad, Queensland toad and eventually the cane toad, did have practical applications. In the early nineteenth century the toad was taken from its home in Central and South America to the sugar plantations of the

Caribbean to catch insect pests – and rats as well² – because it eats whatever comes within range applying an inbuilt logic: if it's big, avoid it; if it's small, eat it; if it's in between, mate with it – scarper, scoff or screw.

Pest problems in Queensland's new cane fields in the late nineteenth century were much like those in the Caribbean sugar plantations; white grubs, the larvae of local species of greyback canegrubs sometimes called witchetty grubs, attacked roots of sugar cane in preference to tough old native grasses. And the Caribbean experience was so widely known that when Albert Koebele – a disciple of Charles Valentine Riley, the father of biological control – visited Australia in 1888 he recommended 'without doubt the presence of toads ... would have a remarkable effect in diminishing the number of these [greyback canegrubs] as well as many other injurious insects.'³ But no-one followed up his advice at the time.

In 1898, after a brief war with Spain the United States of America flexed its new-found colonial muscles to take control of Cuba, Puerto Rico, the Philippines, and Guam, and annexed Hawaii in the same year. Louisiana's sugar planters were handed a wealth of new territories – and pests to go with them. Sugar linked America's new lands with Australia; James Chataway, a Mackay sugar planter was the Queensland correspondent of the paper *The Louisiana Planter and Sugar Manufacturer* and later, as Minister for Agriculture and Stock, he brought Walter Maxwell from Hawaii, and formerly of Louisiana, to evaluate the state of the sugar industry of Queensland⁴. In December 1900 the Bureau of Sugar Experiment Stations (BSES) was established under the Queensland Department of Agriculture and Stock with Walter Maxwell as Director employing a succession of American scientists, as well as locals, to solve the sugar industry's problems.

The United States Department of Agriculture trained staff to deal with the troubles of emerging agriculture in the new lands; white grubs became so bad in Puerto Rico that in the early 1920s the Agriculture Experiment Stations on the island imported cane toads from Jamaica and Barbados⁵. Within ten years of their introduction toads were everywhere and white grubs had all but vanished⁶. Was all this the work of the toad? Mrs Raquel Dexter, teaching in the Biology Department of the University of Puerto Rico, devised an experiment to prove the link between the abundance of cane toads and the decline in populations of white grubs. She cut open the stomachs of 301 toads to find that 51% of the insects in the toads' stomachs were 'injurious to agriculture', 42% were 'neutral species', and 7% were 'beneficial' insects⁷ – here was the proof!

In 1932 the world's sugar cane technologists gathered for their Fourth Congress in San Juan, Puerto Rico where Raquel Dexter praised the '... amphibian immigrant which is doing its full share of benefit to our sugar industry and to which this International Congress should pay a tribute of gratitude'⁸.

Queenslander and plant pathologist, Arthur Bell, represented BSES at the Congress, but he did not hear Raquel Dexter's paper because he was busy delivering his own paper in a concurrent session – the curse of conferences even then. But Cyril Pemberton, entomologist for the Hawaiian Sugar Planters' Association, chaired Raquel Dexter's session. He was so taken with the 'proof' that he purchased two suitcases and stuffed them with wood shavings and 152 toads before he sailed for New York, then took a train to San Francisco and a steamer across the Pacific to release the toads in their new home in Hawaii⁹ – 149 survived.

This was the *Great Leap Forward* for the cane toad; the voyage in 1932 of two suitcases of toads from the Caribbean Sea to the middle of the Pacific Ocean was the greatest geographical leap *Bufo marinus* had made, and survived to breed, in forty million years. And, with Cyril Pemberton's enthusiasm, Hawaii became the epicentre of the toad's radiation into the islands of the Pacific.

This is where Australia's problems begin – the myth of scientific proof. Mrs Dexter's experiment proved only what the toads had eaten for their last meals and what was slow to digest – worms did not get a look in – it proved nothing at all about the dynamics of populations of toads and

white grubs. She should have asked if the toads' ability to eat anything that wandered close had any effect on populations of female beetles, or on the overall number of eggs laid, or on the number of beetle eggs turning into white grubs in cane fields. And what impact did changes in climate, varieties of cane, cultivation techniques, irrigation and the use of fertilisers have on populations of white grub in cane fields in the decade since the introduction of the toad? But the real conundrum is that Cyril Pemberton, a senior scientist in a respected institution, accepted her conclusions as proof and with such gusto that he populated Pacific islands with toads. In Puerto Rico today, according to Dr David Jenkins entomologist in the USDA Mayaguez Research Station, white grubs are back as a pest and the toads are as abundant as ever¹⁰.

Interest in the toad in Australia was slow to build. In a letter written in September 1933 to his staff at Meringa in north Queensland, Arthur Bell asked whether they thought the toad would help control greyback canegrubs. Reg Mungomery, Assistant Entomologist, replied to his boss; he did not think toads would be much use because adult female beetles were vulnerable for less than an hour after emerging from the soil before they flew to trees to feed, and the common green frog was already known to eat them with little overall impact on populations¹¹. There was no hurrah for the toad at Meringa.

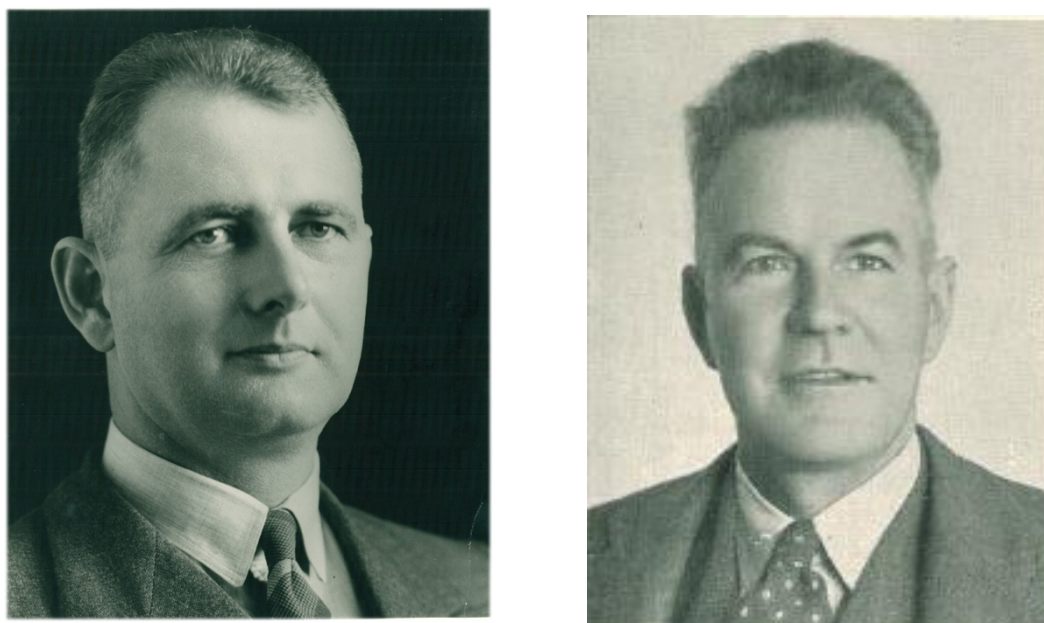


Plate 1 Arthur Bell, Pathologist, and Reg Mungomery, Assistant Entomologist, BSES¹²

The giant toad was ugly, but in 1933 so was the control of white grubs: soil fumigation with carbon bisulphide or paradichlorobenzene, drilling white arsenic (arsenic trioxide) into the soil, or dusting with Paris Green (copper acetoarsenate)¹³. By contrast, biological control was much more pleasant and was in vogue in Queensland in the 1930s because Australian ladybird beetles – called *Vedalia* beetles – had been used to control cottony cushion scale infestations in the Californian citrus industry¹⁴. Queensland scientists had also introduced the moth *Cactoblastis cactorum* from Argentina to control another introduced pest, the prickly-pear cactus. Methods of eradication of prickly pear were vile and ineffective, including arsenic pentoxide, sulphuric acid, and arsenous chloride sprayed by men on horseback¹⁵. The Commonwealth Prickly Pear Board tried around 150 different species of insects to control the cactus pest with little success until larvae of the moth proved successful. By 1928 the moth had eradicated the cactus in Queensland – Reg Mungomery was on the team.

The *Cactoblastis* moth was as spectacularly successful in Queensland as the *Vedalia* beetle was in California, and these well publicised successes set the scene for the acceptance of biological control in agriculture around the world.

The 1934 season was a good one for greyback cane grubs in Queensland – a bad one for cane growers¹⁶ – and BSES was expected to solve the problem. By the start of 1935 Reg Mungomery had completely changed his mind about the toad. He had read Raquel Dexter's paper and reports of the toad in the West Indies; he wrote to Arthur Bell to say that he now thought the toad would be beneficial in eating not only adult beetles, but also weevils, borers, caterpillars, and rats¹⁷. Bill Kerr, Director of BSES, began arrangements to send Reg Mungomery to Hawaii to collect a colony of giant toads.

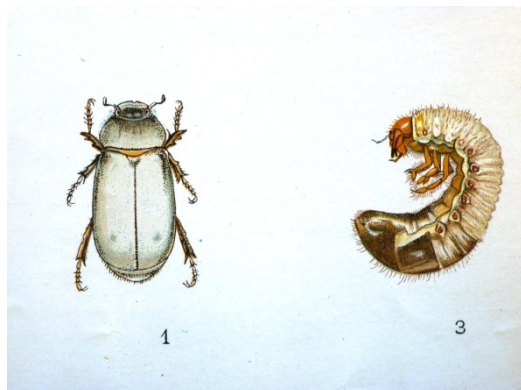


Plate 2 Greyback cane grub (right) and adult beetle (left) drawn by Edmund Jarvis of BSES¹⁸

In March 1935 Dr John Cumpston, the Commonwealth Director General of Health approved importation of the toads¹⁹ – it was an unremarkable event. At the time, the Commonwealth's Quarantine Act, rather than being concerned with importation of pests, was designed to prevent epidemics of influenza and plague in humans and in controlling the importation of diseased plants and animals²⁰.

Reg Mungomery sailed for Hawaii in April 1935 and returned to Sydney on the Matson Line's *Mariposa* in the middle of June 1935 travelling cabin class with 102 toads – the equivalent of business class travel today. After breeding them in Meringa, Reg Mungomery released 2,400 toads into the Little Mulgrave River and other sites around Gordonvale in northern Queensland on the 19th August 1935²¹, just one week before the start of the Fifth Congress of the International Society of Sugar Cane Technologists, hosted in Brisbane by BSES – the successor to the Puerto Rico Congress of three years earlier.



Plate 3 Delegates to the Fifth Congress of the International Society of Sugar Cane Technologists photographed on the steps of Brisbane Town Hall in September 1935. Cyril Pemberton and Arthur Bell are, respectively, third and fifth from the left in the front row²²

At the Congress, the chief advocate of the toad – Cyril Pemberton from Hawaii – was on hand when Reg Mungomery reported the successful captive breeding of the toad and its release. Congress delegates later viewed the toads at Meringa where the Queensland Minister for Agriculture and Stock, Frank Bulcock, opened the research station²³. But after the Congress on the 8th November 1935 Bill Kerr, Director of BSES, received a bombshell – a telegram from Dr Cumpston of the Commonwealth Department of Health which prohibited further releases of the toad. The post-Congress euphoria evaporated.

The BSES files reveal the chain of events that led to the ban and the flurry of activity that followed. At the close of the Congress, Cyril Pemberton had gone to Sydney to board his ship home to Hawaii, and with some time to spare he had caught up with a colleague, Walter



Froggatt, retired New South Wales government entomologist and then President of the Naturalists' Society of New South Wales. Froggatt was dismayed over Pemberton's news of the introduction of the toad to Queensland and immediately lobbied the Commonwealth Government to ban further releases of toads warning that "This giant toad, immune from enemies, omnivorous in its habits, and breeding all year round, may become as great a pest as the rabbit or cactus"²⁴.

Plate 4 Cyril Pemberton watching toadlets newly released in the Mulgrave River, north Queensland September 1935²⁵

Sir David Rivett, Chief Executive Officer of the Council for Scientific and Industrial Research (CSIR) – the fore-runner of CSIRO – was brought into the debate but he supported BSES saying 'I am very glad to know that Mr C E Pemberton is prepared to defend the wisdom of the importation despite the decidedly pessimistic forecast of the New South Wales entomologist'²⁶. But his support was self-serving because CSIR was working on the release the European toad, *Bufo vulgaris*, to control pests in pastures. And there was additional support for the toad from Robert Veitch, the Chief Entomologist of Queensland, and representation in person from Arthur Bell in Canberra²⁷, but Dr Cumpston was un-moved.

It was time for the sugar industry to flex its considerable electoral muscles. The Director of BSES, Bill Kerr, wrote to the Australian Sugar Producers' Association and the Queensland Cane Growers' Council announcing the ban. The Council's Secretary, Bill Doherty, immediately telegraphed his members asking for '... strong agitation against Federal authorities'²⁸. Bill Kerr also briefed his Minister, Frank Bulcock, who in turn sent a glowing recommendation of the toad to the Premier of Queensland, William Forgan Smith, suggesting he make representations to the Prime Minister²⁹. Forgan Smith was a former Minister for Agriculture and Stock and represented the sugar seat of Mackay; he had championed the sugar industry through the Depression³⁰ and he had recently addressed international delegates at the Sugar Technologists' Congress.

But here the paper trail ended; BSES had no need to see the correspondence between the Premier and the Prime Minister and I had to track the next letter through the Queensland State Archives. And there it was. On the 2nd December 1935, Forgan Smith sent the Prime Minister, Joseph Lyons, an almost verbatim version of Bulcock's letter – a copy of the original letter from Bill Kerr – requesting the ban be lifted³¹. The very next day Dr Cumpston telegraphed the Queensland Under Secretary for Agriculture and Stock to partially lift the ban, and the Prime Minister added later that '... no objection would be raised against the release of toads in those areas in which liberations have already been made'³² – the Cairns, Gordonvale and Innisfail region. Here was the smoking gun; support for the toad went right to the top and the strength of the sugar lobby was enough for Joseph Lyons to over-rule his Head of the Department of Health – in an instant.

An unhappy Dr Cumpston wrote to the Queensland Under Secretary to say 'It is recognised, of course, that your Government is prepared to accept its share of responsibility for the action which is now being taken'³³. BSES still wanted the ban lifted completely because cane growers

were now calling for their allocation of toadlets, but first they had to satisfy a snubbed and unhappy Dr Cumpston.

Walter Froggatt's criticisms of the toad became public in January 1936 when his article was published in *The Australian Naturalist*³⁴. As a former government entomologist, Froggatt had been responsible for knocking other crazy proposals for biological control on the head, including red meat-ants from South Africa to destroy baby rabbits in their burrows, ferrets, stoats, weasels and the mongoose to exterminate rabbits, and vultures from Texas to control blowflies³⁵. About the toads he wrote: 'There is no limit to their westward range, and [they] ... will probably adapt themselves to our mountain ranges, and even reach the river banks and swamp lands of the interior'³⁶.

There in the BSES files, among the bland carbon copies of official correspondence, is a letter from Walter Froggatt to Arthur Bell, hand-written on the letterhead of the Naturalists' Society of New South Wales, graced with their gum leaf emblem. With a career of experience behind him and summoning as much passion as possible in the two dimensions of the page and the protocol of the medium, in a cursive hand Walter Froggatt had written '... no organisation, or even a single state of the Commonwealth has the right to independently introduce such a possible menace to the continent as *Bufo marinus*'³⁷.

In July 1936 the Queensland Under Secretary for Agriculture and Stock collated the BSES defence of the toad for the benefit of Dr Cumpston; it included a detailed critique of Froggatt's article, a letter from Cyril Pemberton supporting the '...beneficial and innocuous creature'³⁸, a review of literature, and a further character reference for the toad from Hawaii. In August 1936 Arthur Bell, perpetuating the charade of science, sent Dr Cumpston yet another copy of Raquel Dexter's paper and a repeat of her experiment on toads by the staff of BSES except, inexplicably, in this case they examined the toads' excreta for evidence of their last meals³⁹.

Two studies of the toads' diet seemed to convince Dr Cumpston – there was no request for additional ecological studies; he lifted the ban on the wider release of the toad in September 1936⁴⁰. But the damage had been done a year earlier when the first toads had been released. With a female toad capable of spawning around 30,000 eggs at a sitting there was no hope of getting those tadpoles back in the jar.

The BSES team at Meringa continued to breed and distribute thousands of cane toads around the sugar growing areas of Queensland for at least another three years.

Reg Mungomery's initial reaction was right – cane toads did not control white grubs. And Walter Froggatt was a prescient critic – cane toads reached far beyond the Kakadu wetlands. The toad's colonisation of a four thousand kilometre band of tropical and subtropical Australia has been the greatest mass migration in its globe-trotting history.

Today, it is easy to point a derisory finger at the individuals involved and the three critical errors they made. First, their assumption that the toad would control greyback canegrubs was wrong because the feeding habits of the toad did not coincide with the swarming habits of the adult beetles. Second, the interpretation of Raquel Dexter's experiment as proving the link between the feeding habits of the toad and a decline in populations of white grubs was fundamentally flawed. And third, there was no recognition of Walter Froggatt's warning of the ecological impact of a toxic amphibian on the fauna of subtropical and tropical Australia.

The premise was bad, the assumptions flawed, and the execution reckless.

Who was to blame? Did the sugar industry and the politicians pressure the scientists into precipitate action? Or did the scientists foist their idea on an industry and government who trusted them? Or did they all work together on an idea that they all believed would be the saviour

of the sugar industry? Bits of evidence can support each case. But blame is pointless – there is no recourse.

Instead, we need to learn what went wrong so as to avoid a repeat performance. There appears to have been no fault in following quarantine procedures at the time; we can fault the procedures but later amendments to the Quarantine Act closed the gaping holes. The main problem seems to have been the blinkered chain of command that believed that what it was doing would help the sugar industry. The problem lies within the people and the mind-set of the times.

Think back to 1935. The Sugar Technologists' Congress met in Brisbane under what its President called 'a continuance of the acute economic depression which has enveloped the entire world'⁴¹; Franklin Roosevelt was implementing his New Deal to lift America out of economic depression, and the rumblings of war accompanied the flaunting of the Versailles Treaty by the Chancellor of Germany, Herr Hitler. A mind-set of war prevailed at home; Sugar Regulations gave financial encouragement for white labour to populate tropical Australia with what sugar growers called 'a defensive garrison' against a 'temptation to Asiatic invasion'⁴², and scientists believed they were engaged on behalf of mankind in 'continuous warfare upon the insects' which attacked the cane⁴³. This was the milieu of Bill Kerr, Arthur Bell and Reg Mungomery of BSES, Bill Doherty of Queensland Cane Growers' Council, Robert Veitch Queensland's Chief Entomologist, Sir David Rivett the Head of CSIR, John Cumpston the Director General of Health, William Forgan Smith the Premier of Queensland, and Joseph Lyons the Prime Minister of Australia. These were men of their times; not evil men bent on populating Australia with a toxic pest.

Now ask, if you were one of them, what would be your response to a carping critic who in 1935 wanted to know 'What affect will releasing tadpoles in the Little Mulgrave River in Queensland have on the ecology of the Kimberley region on the other side of Australia?'

Clearly, people at all levels of the decision to import the toad should have both asked and answered it – but they didn't.

Is science the culprit? The toad was championed by qualified scientists, some eminent in their fields, but scientists are not an homogenous breed. The science philosopher Sir Peter Medawar⁴⁴ described them well; '... among scientists are collectors, classifiers, and compulsive tidiers-up; many are detectives by temperament and many are explorers; some are artists and other artisans', and scientists tell stories and publish them '... stories which might be about real life, but which have to be tested very scrupulously to find out if indeed they are so'. Some of the breed of scientists will argue that the 'scientific method' of hypothesis and testing was not applied in the case of the toad, but that is how science is *reported* not necessarily how it is *done*; science is rather more haphazard and the wastelands of scientific endeavour are dotted with blooms of serendipity. It is easy to say that by today's standards the science behind the introduction of the toad was poor, but it should be judged by the standards of 1935 not by the standards of today. What is more worrying is that the number of qualified scientists supporting the toad indicates that the standard of scientific evidence must have passed as acceptable for the times.

We can be appalled by what passed as acceptable science in 1935 but in seventy five years time our descendants will be appalled by our actions; by our profligate use of energy and water, the gross imbalance of our carbon economy and the naivety of our genetic manipulation. But will they also be appalled by what we think of as good things that we have done? Just as in 1935, each generation of researchers believes it is at the forefront of science, but the front keeps moving and researchers are left in its wake. And in the end, good science will deliver a good scientific outcome – it will not guarantee a benign one.

Could it happen again today? Could another alien organism, championed by respected scientists, government departments and politicians, be released in Australia? Consider the 1935 proposal in the light of modern criteria for research funding and imagine the PowerPoint presentation;

The cane toad

- *builds on successes in biological control*
- *replaces toxic pesticides*
- *is supported by a published scientific paper*
- *has international scientific peer review*
- *is endorsed by Australia's leading science body*
- *is championed by the industry*
- *is promoted by the Queensland Government and its Premier*
- *is approved for use by the Commonwealth Government and*
- *has personal endorsement from the Prime Minister.*

It is a dead-set winner – straight to the top of the funding list – yes, it could happen again.

The toad was championed in Australia by a herd of supporters including scientists, industry people and governments, but in each herd there are people like Walter Froggatt who can see further than the rest, who can see the precipice, but whose voice is lost in the thunder of hooves. In a stampede the collective ego is blind, the herd instinct is contagious and nay-sayers get trampled. But that is just the time when we must turn the mob, settle the herd and ask questions which could have them all grazing quietly once more. We must ask for scrupulous testing of the stories scientists tell and question assumptions about the ecological impacts – in seventy five years time or more – of the organism they are releasing now.

Sadly, until today's scientists can remedy the catastrophe of their predecessors' making, much of the fauna of the Top End of Australia will have to live or die by the toad.

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