EDITORIAL

‘Seeing Weeds with New Eyes’ Part II– Some Historical Perspectives and ‘Proto Weeds’

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“…What is a weed? A weed is a plant whose virtues have not yet been discovered…”

Ralph Waldo Emerson (1863)

Emerson, a renowned American philosopher, and poet, who led the transcendentalist movement of the mid-19th century in the USA, had an enlightened view of weeds. Those words, spoken in a famous speech, ‘*Fortune of the Republic’*, in December 1863, against the backdrop of the American Civil War (1860-65), are often quoted in *Weed Science* textbooks. Their deeper meaning is: Weeds *do* have admirable virtues, and one would see them if one looked closely.

As I said previously (Chandrasena, 2019), the incessant slandering of colonizing plants (weeds) by some people is a critical issue for *Weed Science*. It has inhibited the emerging generation of weed scientists from appreciating the utilitarian values and other redeeming qualities of weeds, as well as their ecological roles. It also prevents weed research from operating under a different paradigm and proving the worth of colonizing taxa, while controlling them to the extent necessary with sustainable approaches.

Weeds are plants with colonizing attributes, which thrive on habitat disturbed by man (such as agricultural fields), or by natural phenomena. As they are ‘pioneers of secondary succession’ (Baker, 1965; Bunting, 1965), ‘disturbances’ are the key. They grow where someone does not want them, and often that is in areas that have been disturbed or altered intentionally. Weeds grow especially well in gardens, cropped fields, golf courses, and similar places.

As Zimdahl (2007, p. 20) wrote, the ability of weeds to grow in habitats that have been disturbed by man makes them a kind of ecological ‘Red Cross’: They rush right into disturbed places to occupy those places and then, restore the land.

Weeds, important in crop competition, are often present in the earliest ecological successional stages (the ‘ecological Red Cross’; Zimdahl, 2007, p. 256) following abandonment of crop lands because there is an absence of competition and a large weed seed bank in the soil that still has abundant nutrients.

‘*War with Weeds*’, a common slogan bandied around in popular media, is the wrong choice of words to describe how we should manage weeds. Some weed scientists and agriculturists still live with the delusion that we can win a ‘war-with-weeds’ using herbicides as ‘weapons of mass destruction’ (WMDs). These views need to be challenged, as they mislead the public and are also unsustainable and counter-productive (see Low and Peric, 2011; Dwyer, 2012).

Continuing the theme ‘*Seeing Weeds with New eyes*’ (Chandrasena, 2019), in this issue of *Weeds*, I expand on some historical perspectives on matters related to colonizing taxa that have not received much attention within our discipline. My hope is that the emerging generation of weed scientists may benefit from deeper insights about the discipline’s history and how our attitudes towards weeds have changed and evolved with time.

I also provide a brief account of some recent archaeo-botanical findings from the Levant, that push the record of first-known weeds back 23,000 years to a time well before settled agriculture.

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Human attitudes towards ‘weeds’ appear to slowly change over time, through the 1st and 2nd Millennia A.D. Reviewing the history of Weed Science, Timmons (1970) reported that: “*available literature indicates that relatively few agricultural leaders and farmers became interested in weeds as a problem before 1200 A.D. or even before 1500 A.D*.”

The general attitude seemed to be that: "*weeds were a curse which must be endured, and about which little could be done except by methods which were incidental to crop production, and by laborious supplemental hand methods*" (Timmons, 1970). Much of the time, it appeared that weeds were '*manageable with some effort*'. Farmers, who made a living by growing crops, considered weed control only as an '*incidental*' activity to land preparation and other cultural practices. The early agriculturists were more concerned with crop damages and losses caused by insects and plant pathogens, which were spectacular, compared with negative effects of weeds.

During the last three centuries, discoveries, such as steam power gave rise to industrial-scale agriculture. As the industrial revolution transformed agricultural societies into manufacturing societies, attitudes changed. Over time, intolerance of any obstacles to productivity and profits crept in, as humans flourished across many parts of the world.

The 18th century could well be considered as the most transformative for agriculture. It saw a revolution in large-scale food production, due to both efficient land preparation and monoculture cropping. This period also saw major efforts to control agricultural weeds with human and animal labour. The negative attitudes towards weeds hardened in the USA during the 19th century as agriculture expanded on a large scale (Timmons, 1970).

Jethro Tull's musings

In the middle of the 18th century, an English inventor, Jethro Tull (1674-1740) revolutionized tillage practices in agriculture in Britain. His seminal book -*The New Horse-Hoeing Husbandry*, written in 1731, was among the first to extensively use the word 'weeds' in its present meaning. Tull's horse-drawn seed drill invention was one of the first that began the mechanical era of agriculture.

Tull mistakenly believed that particles of the earth were the 'food' of plants and that pulverization of soil particles through tillage made it easier for plants to absorb these nutrients. He advocated cultivation as a substitute for crop rotation, fertilizer, and fallow. Although Inter-row cultivation would have accomplished weed control, weeds were not an important part of his hypothesis about plant nutrition. Zimdahl (2010, p. 30) points out that:

> *"…Tillage surely accomplished weed control but weeds were not an important part of his hypothesis about plant nutrition. Plant nutrition was derived from what Tull called infinitely divisible particles of earth. Tillage made the particles small and thereby plants were nourished. Tull's hypothesis was false in all respects but he deserves credit for promoting the new practice of cultivation even though he ignored its benefits for weed control…"*

The 'hoe' probably was better adapted for weed control than the ploughing, even though its intended function was pulverizing the surface soil so that ''*the needed soil elements could be absorbed more readily by plant roots*'' (see Timmons, 1970, quoting Tull).

Herbae inutiles and *Herbae noxiae*

My reading of Tull is that while he may not have promoted tillage for weed control, he certainly implied it. Writing a full chapter and more on weeds, he appreciated the strengths of weeds, while detesting them as constraints to farming. Tull likened weeds in farmer's fields to '*muscae*', a reference to domestic houseflies (*Musca domestica* L.), who are '*uninvited guests*' along with other domestic pests. At the start of Chapter VII - "*Of Weeds*", Tull muses as follows:

> *"…..Plants that come up in any land, of a different kind from the sown, or planted crop, are weeds….That there are in Nature any such things as inutiles Herbae, the Botanists deny; and justly too, according to their meaning. But the farmer, who expects to make profit of his land from what he sows or plants in it, finds not only Herbae inutiles [1], but also noxiae, unprofitable and hurtful Weeds; which come like Muscae or uninvited guests, that always hurt, and often spoil his crop, by devouring what he has, by his labour in digging and tilling..."*
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> *"…All weeds are pernicious, but some much more than others; some do more injury and are more easily destroyed; some do less injury, and are harder to kill; others there are, which have both these bad qualities. The harder to kill will propagate by their seed, and also by every piece of their roots, as couch-grass, coltsfoot, melilot, fern..."*
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> *"…Some are hurtful only by robbing legitimate (or sown) plants of their nourishment, as all weeds do; others both lessen a legitimate*

[1] The Latin term: *Herbae* refers to 'herbs' or 'grass'. '*Herbae inutiles*' refers to 'useless, unusable' the opposite of *utilis* = useful. *Herbae noxiae* (from the Latin word '*noxia*', meaning 'harmful plants'.

crop by robbing it, and also spoil that crop, which escapes their rapine, when they infect it with their nauseous scent and relish, as melilot, wild Garlick…"

Tull's book is full of sketches that show a degree of respect for weeds. By categorizing some plants as useless and unusable, while others may be more injurious and harmful, his writings gave rise to the popular modern-day adjective '*noxious*', attached to some weeds. Yet, he said that some botanists might disagree with this viewpoint, which mirrored the way farmers looked at these problematic plants.

In his book, Tull also discussed the growth and reproductive strategies (such as the production of seed and underground vegetative structures) of many weeds. He also had some harsh words for farmers, whom he told to pay greater attention to weeds and annihilate them as a 'whole race' in a manner like how the '*much more innocent and less rapacious*' wolves (*Canis lupus* L.) were eradicated from Britain [2].

"…It is needless to go about to compute the value of the damage weeds do, since all experienced husbandmen know it to be very great, and would unanimously agree to extirpate their whole race as entirely as in England they have done the wolves, though much more innocent and less rapacious than weeds..."

As Timmons (1970) says, Jethro Tull, therefore, must be judged as a crusader against weeds urging their extermination from Britain. Notions of the possibilities of 'weed eradication', perhaps, arose out of such writings. With many global examples, we now know that, once established, colonizing taxa are hard to 'exterminate' or 'eradicate, unless they are small populations detected early and subject to control.

However, Tull's efforts were primarily aimed at selling his invention - horse-drawn hoeing - as a new tillage practice in Britain and Europe, where he had travelled widely making observations on how farming was done. As the sub-title indicates, the book was:

"Designed to introduce a new method of culture; whereby the produce of land will be increased, and the usual expense lessened".

It would be fair to assume that his invention allowed the 18th century British farmers who adopted the horse-drawn hoe to grow crops in rows and attain better growth conditions in the fields. The tillage practices would have simultaneously achieved a high degree of weed control in the row-sown crops.

William Darlington's *American Weeds and Useful Plants*, 1859

In tracing how attitudes towards weeds evolved over time, a particularly fascinating account comes in the introduction of William Darlington's book on '*American Weeds and Useful Plants*', published in 1859 (Darlington, 1859, pages xv-xvi). The book had been first published in 1847 under the title *Agricultural Botany* and was later reissued as with a new title and illustrations (see cover, Figure 1).

Dr. Darlington (1782-1863) was a famous American medical doctor, a physician who had travelled extensively when young, and in later years, a US congressman for Pennsylvania [3]. He was also a highly-respected, amateur botanist (Nickerson, 1936; Flannery, 2017) who maintained close contact with several world-renowned botanists. Botanists with whom he enjoyed '*an eminent degree of friendship*' (Nickerson, 1936) included the Swiss botanist Augustin de Candolle [4] in Geneva, and Asa Gray [5] and John Torrey [6] [7] in the USA.

[2] Wolves (grey wolf) were once abundant in the British Isles but were hunted from Roman times (>2000 years ago). The dates when last wolf in the British isles was killed are disputed - in 1680 or 1743 and they may have survived until the early-19th century. (source: **https://en.wikipedia.org/wiki/Wolves_in_Great_Britain)**

[3] William Darlington – Wikipedia – Source: **https://en.wikipedia.org/wiki/William_Darlington**

[4] Augustin Pyramus de Candolle (1778-1841) – a Swiss Botanist originated the idea of "Nature's War", which influenced Charles Darwin and the principle of natural selection as the primary driver of evolution.

[5] Asa Gray (1810-1888) is one of the most important American Botanist of the 19th century. His *Darwiniana* – a collection of essays, responding to Charles Darwin's *Origin of Species* (1859) attempted to show how religion and science were not mutually exclusive. Gray was adamant that a genetic connection must exist between all members of a species.

[6] John Torrey – A New York Botanist of high reputation. He gave William Darlington, perhaps, his greatest homage in 1853, by naming a newly discovered Californian plant, found in 1841 – the Californian pitcher plant or cobra plant – originally named *Darlingtonia californica* Torr. (1853).

[7] Nickerson (1936) records that it was de Candolle who first honoured Darlington with the naming of the genus in 1825, but due to a question of priority, the name was not accepted. Dr. Torrey, then, described the species again in 1953, dedicating it to honour Darlington.

Darlington was a keen advocate for applying scientific knowledge of plants to improve 'old agriculture'. Presumably, what he meant was more extensive knowledge about the life cycles, and factors, which contribute to the growth of both crops and weeds in farmers' fields. The author's dedication in the book emphasized his motivations:

> *"..To The Young Farmers of the United States, this humble attempt - to aid and persuade them to cultivate a Department of Science- essential to an enlightened Agriculture and indispensable to an accomplished yeomanry…"* [8]

Figure 1- Cover of William Darlington's American Weeds and Useful Plants, 1859

'Plants Out of Place' and unwelcome intruders

The history of *Weed Science*, reviewed by others (Timmons, 1970; Evans, 2002; Falck, 2010; Zimdahl, 2010) shows that weed scientists, for more 100 years, accepted the notion that weeds should not be tolerated and that they are unwanted. *How did this notion arise*? In my reading of history, Darlington's book, written with noble intentions, popularized this idea in the mid-19th century.

The definition of a weed as '*A Plant Out of Place'*, which arose in the USA, can be traced back to his writings. However, Darlington clearly states that the notion was an '*old one*' (see quote below) and had evolved before his time. However, his book may have popularized the notion among the agricultural communities in the USA and elsewhere [9]. The quotes below open his six-page introduction to weeds in the 1859 Edition:

> *"…In popular language any homely plant which is not noticeable for the beauty of its flowers, not entitled to respect by a reputation for medicinal or other useful qualities, is designated by the epithet weed. In an agricultural sense, the term is used with a more restricted meaning, and is applied to those intrusive and unwelcome individuals that will persist in growing where they are not wanted – in short, the best definition that has yet been given of a weed is the old one. "**a plant out of place**…"* (p. xiii)

> *"…Most of the weeds troublesome in our agriculture are immigrants, either from the Old World, or the warmer portions of this continent. The number of plants indigenous to our country, entitled to rank as pernicious weeds, is comparatively small..."* (p. xiii)

Writing from his resident state, Pennsylvania, which had previously seen the ravages of war during the European colonization, Darlington invoked the notion that nearly all 'pernicious' weeds were immigrants from the Old World (Europe). To him, weeds were '*unwelcome intruders*', *with no value and weeds also persist in growing where they are not wanted*. Interestingly, from his viewpoint, only a small number of indigenous plants of the USA qualified as pernicious weeds.

Darlington's writings clearly depicted the close relationship between human immigration and plant immigration: wherever humans go, some plants will follow them. Such ideas, written so unambiguously as advice, may have influenced the 'next generation of US agriculturists, 'the young farmers', Darlington was keen to address. Perhaps, these thoughts, penned at a time when the USA was heading towards the Civil War (1860-65), in some way changed the attitudes of farmers. It was evident to him that farmers need to have considerable respect for weeds, something they did not have at that time.

[8] 'Yeomanry' is a term applied to the body of small landed proprietors of the middle class, anxious to live self-sufficiently by cultivating their land.

[9] A chronological summary of definitions of weeds can be found in Zimdahl's Fundamentals in Weed Science (3rd Edition, 2007. P. 17).

Figure 2. A portrait of William Darlington (Source: Wikipedia: https://en.wikipedia.org/wiki/William_Darlington**)** [10]

Darlington's style included the use of powerful metaphors to stress a point. Other sections of the Introduction show a degree of indifference towards Indigenous Americans, whom he used as metaphor:

> *"…As the aborigines disappeared with the advance of the whites, so do the native plants generally yield their possessions as cultivation extends, and the majority of the plants to be met along the lanes and streets of villages, and upon farms, are naturalized strangers, who appear to be quite at home, and are with difficulty to be persuaded or driven away…"* (p. xiii)

The reference to the retreat of the Indigenous Americans as the 'whites' advanced, brings up images of violent conquests, which took place during the European colonization of the Americas. A much more accurate description would be 'pushed out of the away' or 'decimated' rather than 'retreat'.

The history of the USA, recorded elsewhere, shows that Indigenous Americans did not entirely 'disappear'. Against the wishes of the 'whites', they do exist, centuries later, but as marginalized people, just as other dispossessed and relegated Indigenous peoples exist elsewhere.

It is also important to note that even as an amateur botanist, it was clear to him that colonization by 'human immigrants' arriving from the Old World would be followed by plant immigrants. He highlighted that the new immigrants would soon become 'naturalized' in their new environments, and some would be hard to be 'persuaded to leave' or '*be driven away'*. Persistence of weeds after establishment is an ecological fact and a major theme in ecology. I agree with Zimdahl's judgement (*pers. comm.*, June 2020) that, unfortunately, it has never been a central theme in Weed Science since the time the discipline was formed ca. 100 years later.

> *"…In agriculture, as in morals, idleness is the mother of vice, and if the ground be not occupied with something good, there will be plenty of the opposite character to take its place. Possession is a great advantage in other matters than those of the law, and a plant, whether useful or troublesome, when once fully established is not disposed to yield without an argument..."* (p. xiii)

These astute observations on the nature of weeds show that even as an amateur agriculturist and botanist, Darlington understood weeds well. It was clear to him that weedy plants would be the first colonizers, who 'take possession' of a vacant and disturbed area, such as 'agricultural fields', 'lanes and streets of villages'. In such areas, the 'naturalized stranger' may thrive. And once established these persistent plants will not leave '*without an argument'*. Indeed! The clarity of thought is evident.

As a discipline, ecology had not quite developed in the mid-19th century. Therefore, such ideas, written more than 170 years ago, in 1847, are predictors of our understanding of how and why weeds behave as they do. Giving good agronomic and scientific advice, describing '*idleness as the mother of vice'*, Darlington also emphasized that: *farmers would do well to not be idle in dealing with weeds*.

Correspondences with de Candolle

The correspondences Darlington had with de Candolle are particularly interesting for students of *Weed Science*. The account (see below) relates to de Candolle's concept of all plants being perpetually at war with each other (i.e. 'Nature's War'), which initiated the concept of allelopathy (Rice, 1984).

[10] Portrait of William Darlington, painted by John Neagle, about 1825. West Chester University, West Chester, Pennsylvania (Source: **https://en.wikipedia.org/w/index.php?title=William_Darlington&oldid=927853133**

> *"…That learned and sagacious observer of Nature – the late Professor De Candolle remarks, that,*
>
> *"…all the plants of a country, all those of any given place, are in a state of war, in relation to each other. All are endowed with means, more or less efficacious, of reproduction and nutrition. Those which first establish themselves accidentally, in a given locality, have a tendency, from the mere fact that they already occupy the space, to exclude other species from it; the largest ones smother the smallest ones; the longest lived ones supersede those of shorter duration; the most fruitful gradually take possession of the space which would otherwise have been occupied by those which multiply more slowly…"*
>
> *"…The farmer, therefore, should avail himself of this principle, and aid the more valuable plants in their struggle to choke down or expel the worthless…"* (p. xiv)

In 1805, de Candolle had written about a 'soil sickness' as part of a 'Nature's war', reporting that some plants excreted substances from roots that were harmful to other plants. He noted the specific inhibition of oat (*Avena sativa* L.) by thistles (*Cirsium* sp. L.) and of wheat (*Triticum aestivum* L.) by ryegrass (*Lolium* sp. L.). He reasoned that in the natural environment, such interactions have potential applications in agriculture and that rotation of crops could alleviate the problem (Willis, 2012). De Candolle's early writings about excreted substances from plant roots were an essential part of the history of 'allelopathy', which developed as a sub-discipline within *Weed Science* (Rice, 1984).

Interestingly, the correspondence with de Candolle, referred to by Darlington in 1847, contains no reference to any excreted substances. Instead, de Candolle only invoked what ecologists and weed scientists refer to as 'inter-specific' and 'intra-specific' competition, which are based on jostling for physical space. De Candolle also refers to '*all plants being endowed with the means to efficiently reproduce and obtain nutrition*'.

De Candolle pointed out to Darlington that some plants, taking possession first and occupying the space will lead to physically excluding others; the largest ones will smother the smallest ones; the longest lived ones will supplant or 'supersede' those of shorter duration; the most fruitful (meaning, both fast-growing and more fecund) gradually take possession of the space which would otherwise have been occupied by those, 'which multiply more slowly'.

Darlington saw agriculture as a constant struggle (quote below). He advised young farmers to learn '*something about the nature and character' and peculiar habits of the individuals with which he has to contend*' referring to both the crop and non-crop (weeds). This is important to dissuade the non-crop plants to be ousted and make the others (crops) grow and produce to their 'utmost capacity'.

> *"…The labours of the agriculturist is a constant struggle as he endeavors to make certain plants grow and produce to their utmost capacity; on the other hand, he has to prevent the growth of certain other plants that are ready to avail themselves of these favourable conditions…"*
>
> *"…The farmer is interested in two points concerning weeds: how they get into his grounds, and how to get them out. As cultivation is all the more profitably carried out if the farmer knows something of the nature and character of the plants he would raise, so, if he would successfully operate in the other direction, and stop plants from growing, he can do so all the better if he knew what are the peculiar habits of the individuals with which he has to contend..."* (p. xiii)

As early as in mid-1800s, Darlington stressed the importance of studying agronomic requirements of crops, to make them grow better. At the same time, he wanted farmers to understand why and how weeds get into their fields, so that the pathways could be avoided (i.e. preventative weed control).

On annual seed-producers

Darlington (1859, pp. xiv-xv) writes about various aspects of the biology of weeds that are relevant to their control. His primary objective was to educate the young farmers that they should understand weeds better, along with the botany of the crops they are trying to grow. These are some of the earliest writings of the discipline, which evolved to be *Weed Science*. The attitude for more than 150 years was simple 'weed control'. However, ideas that later developed into the more holistic approach of 'weed management' can be gleaned from the following:

> *"…Weeds are introduced upon a farm in a variety of ways. Many have their seeds sown with those of the crops; this is particularly the case where the seeds of the weeds and of the grain are so much alike in size that their separation is difficult. Proper care in procuring and preserving clean seed will often save much future trouble and vexation..."*

"…The observing farmer will notice the means which nature has provided for the scattering of seeds; he will find that the most pernicious weeds seem to have been especially furnished with contrivances to facilitate their dispersion. The Clot-bur[11], Beggar's lices [12], and others, have barbs and hooks by which they adhere to clothing and coats of animals and are widely distributed through this agency. All of the Thistles have a tuft of fine silky hair attached to seeds, more properly, fruit, by which they are buoyed upon the air and wafted from place to place..."

"…So numerous are the ways by which seeds are distributed, that, however careful a farmer may be upon his own premises, a slovenly and neglectful neighbour may cause him infinite annoyance by furnishing his lands with an abundant supply..." (p. xiv-xv)

"…The vitality of seeds, particularly, if buried in the earth below the influences which cause germination, in some cases endures through many years; hence, an old field, after deep plowing, has often a fine crop of weeds from the seeds thus brought to the surface..."

"…Weeds that have been cut or pulled after they have flowered, should not be thrown into the barnyard or hog-stye, unless the farmer wishes to have the work to do over again with their progeny, as the seeds will be thoroughly distributed in the manuring of the land…"

"…In all weeding, it is of the greatest importance that it should be done before the plants have formed seed. This should be regarded equally with annual and perennial weeds. The prolific character of some weeds is astonishing; each head of an Ox-eye daisy [13] or White weed [14] is not a simple flower, but a collection of great many flowers, each of which produces a seed; and, as a single plant bears a great many heads, the number of seeds that a single individual is capable of supplying in a season amounts to several hundreds…" (p. xiv-xv)

On perennial weeds

Observations on species, such as thistles with deep tap roots and grasses, such as couch grass [15], with rhizomatous underground stems, are particularly pertinent to describing the life cycle of perennial weeds with special attributes. As Nickerson (1936) noted, Darlington was writing at a time when so little had been written on agriculture or weeds.

"…A perennial weed, like Canada thistle or Couch grass, is, during early stage of its existence, easily destroyed; but later in the season it makes strong underground stems, or roots, as they are commonly but incorrectly called, which have great tenacity of life, and which have within them an accumulation of nourishment which enables them to throw up successive crops of herbage; ploughing such weeds generally aggravates the trouble, for unless every fragment be removed from the ground, a thing very difficult to accomplish, each piece that is left makes a separate plant.…"

"…In the case of weeds of this description, the necessity of early eradicating them is apparent, for, if once well established. An underground provision depot formed, the farmer and the plant are placed in the condition of being besieging and the besieged forces – as long as the provisions hold out the latter can maintain its ground…"

"…It becomes a question of endurance, for the underground supply must be eventually exhausted in the attempt to produce new stems and leaves, and if the farmer, by persistently cutting these away, prevents any new accession to the stock of provisions, the enemy must at length succumb…"

"…Often, repeated cutting will at length exhaust the underground portion of its vitality. In some cases, salt has been used with success, especially upon Thistles, applied immediately after mowing…" (p. xv-xvi)

[11] Clot-bur or common cockleburr: *Xanthium strumarium* L. (Asteraceae)

[12] Beggar's lices or stickseed: *Hackelia virginiana* (L.) I.M. Johnston (Boraginaceae)

[13] Ox-eye daisy: *Leucanthemum vulgare* Lam. (syn. *Chrysanthemum leucanthemum* L.) (Asteraceae)

[14] White weed: *Ageratum* L.; (Asteraceae)

[15] Darlington did not quite name the species he called 'couch grass' here. In the USA, Bermuda grass (*Cynodon dactylon* (L.) Kuntze), which he described on p. 377, is sometimes called 'couch grass'. But he was probably referring to the English/European couch grass - *Elytrigia repens* Desv. Ex Nevski (syn. *Agropyron repens* (L.) Beauv.; *Elymus repens* (L.) Gould).

The use of war imagery to describe the subterranean reserves of perennial weeds, is particularly noteworthy. It reflected the time in which he lived, just before the American Civil War, which broke out only one year later (1860-65). ''Provisions depot', 'besieging (farmer) or the besieged (weeds) forces', 'holding out the ground', 'stocks of provisions' and the 'enemy must at length succumb' describe, through jargon associated with wars, what the farmers must do. Strong metaphors indeed to make a point that the young farmers, many of whom had already returned to agriculture after serving in the army or would be doing so at a future date (the word 'yeomanry' in the sub-title also appears deliberate.

In pages xv-xvi of the introduction, there is a paragraph that is particularly striking. Darlington calls weeds as 'evil' and advises the agriculturists to have a 'zero tolerance' attitude towards weeds. To equate weed control to Native American Indians killing women and children of enemies to stop the latter from producing offspring who might seek revenge is an extraordinarily strong and offensive imagery indeed! He picked the wrong metaphor.

> *"…In weeds, evil should be emphatically, nipped in the bud. In this respect, the farmer should act in the spirit of the Western savages who kill the women and children of the enemies, as a tolerably sure way of preventing the multiplication of warriors..."* (page xv)

> *"…The farmer will do well to keep in mind two rules.* ***Do not let weeds flower, and do not let them breathe****, for the leaves may be considered the lungs of the plant, and without the aid of these it cannot long maintain itself…"*

Darlington also wrote strongly on the need for correctly identifying plants, highlighting the mis-identification of Canada Thistle (*Cirsium arvense* (L.) Scop.) with clot-bur (*Xanthium strumarium*). Canada Thistle, a native of Europe and Northern Africa, had been introduced to North America soon after the arrival of European settlers. Its invasiveness was soon recognized. It is historically known as one of the first plants to have noxious weed laws enacted requiring its control: first in Vermont in 1795, followed by New York in 1831 (Timmons, 1970).

On pages 179-80, Darlington described clot-bur (*Xanthium strumarium*) and was scathing in his criticism of law-makers wrongly identifying this species for Canada Thistle. Referring to *Xanthium strumarium*, his observations were:

> *"…This execrable weed believed to have originated in tropical America, and now widely diffused through various parts of the old world, becoming naturalized in many portions of our country,—particularly in the Southern States. It may be frequently seen along the side-walks, and waste places, in the suburbs of our northern sea-port towns, and is a vile nuisance wherever found…"*

While stressing the mis-identification of clot-bur with Canada Thistle, he acknowledged that the misnomer did not harm the enactment of laws across many States to prevent its spread:

> *"…I have understood that the authorities of one of our cities, a few years since, enacted an Ordinance against the plant, in which enactment it was denounced by the name of the Canada Thistle ! The misnomer probably "did not" impair the efficacy of the Ordinance: yet I cannot help thinking it would be decidedly preferable that both law givers and farmers should avoid confounding objects which are essentially distinct, and learn to designate even weeds by their proper names…"* (p. 179-180)

Perhaps, Darlington's writing in the first edition of the book, in 1847 influenced the US law-makers and agricultural advisors to make a correction. As Hartzler (undated) noted, Iowa's first noxious weed law was subsequently written in 1868 by the 16th General Assembly and stated:

> *"..,Be it enacted by the General Assembly of Iowa, that if any resident owner of any land in this state after having been notified in writing of the presence of Canada thistles on his or her premises, shall permit them or any part of the root to blossom or mature, he or she shall be liable to a fine of five dollars and cost of collection for each offense…"*

Darlington's contribution to the development of our discipline is significant, especially, his dedication to promoting agriculture based on science. He was probably the first to write and publish accounts that argue strongly for obtaining:

> *'…An accurate knowledge of the distinctive characteristics, and economic properties, together with a precise nomenclature of those plants that interest the cultivator of the soil..."*

The point Darlington raised in 1847 about correctly identifying weeds is also a historical first that has also not received much attention from historians writing about botany, weeds, or agriculture in the USA

or elsewhere. Weed researchers, nowadays, know how important it is to correctly identify weeds in planning their management.

As opposed to common names, scientific names have a universal meaning. Those who know scientific names will be able to verify a plant's identity by reference to standard texts or will immediately know the plant in question when the scientific name is used. Those who do not share the same native language can make use of Latin, an unchanging language, to share information about plants (Zimdahl, 2010, p. 47).

Darlington's book contains more than 400 pages of accounts on crops, weeds, and other plants that were of interest to him. These botanical descriptions and personal observations on individual species, along with keys to plant families, genera, and species, must rank among the very first published material in the corpus of knowledge in *Weed Science*.

McCarthy vs. Halsted

In a late-19th century Letter-to-the Editor in *Science*, Gerald McCarthy (Figure 3), a botanist from North Carolina (McCarthy, 1892), took exception to New Jersey Professor, Brian Halsted's listing of 750 plants as '*American Weeds*' (Halsted, 1889).

This dialogue occurred between 1889-1892 and is worthy of re-recording as it too has gone largely unnoticed in the *Weed Science* literature. Annoyed by Halsted producing a long list of plants, which included many useful and beneficial species among America's 'worst weeds', McCarthy wrote:

> *"Well may the long-suffering farmers turn up the whites of his eyes at this formidable list".*

Continuing, McCarthy explained that he had indeed tried to clarify with various professionals how they related to weeds. His narrative reads as follows:

> *"…all plants are born free and equal; the distinguishing of plants as weeds and not weeds is purely human and artificial. The popular idea of a weed seems to be a repulsive, or hurtful, wild plant. But few persons give exactly the same definition…"*
>
> *I have taken some trouble to secure the definitions of a number of intelligent persons and give below a few examples: -*
>
> *"A plant where you don't want it – Director, Experiment Station.*
>
> *"A noxious or useless plant" – Curator of Museum.*
>
> *"A troublesome plant" – Chemist.*
>
> *"An obnoxious plant of many species not fit for food or medicinal purposes" – Clerk.*
>
> *"A plant not edible, so far as known, nor medicinal, or otherwise serviceable to man, and which always thrives where not wanted" – Inspector of Fertilizers.*
>
> *"A plant for which we have no use so far as we know" – Meteorologist.*
>
> *"(1) Underbrush or bushes; (2) a useless or troublesome plant" – Webster (Dictionary).*
>
> *My own definition: Any plant which from its situation or inherent properties is hurtful to human interests; a vegetable malefactor…"*

As reported by Troyer (1999) and McCormick (2011), before the turn of the 19th century, two institutional herbaria existed in Raleigh, North Carolina. The oldest was initiated by the first State Botanist, Gerald McCarthy (1858-1915). He was highly respected as a botanist and for his botanical collections and contributions. By 1890, he had presented more than 4000 specimens to the USA's National Museum (Smithsonian Institution).

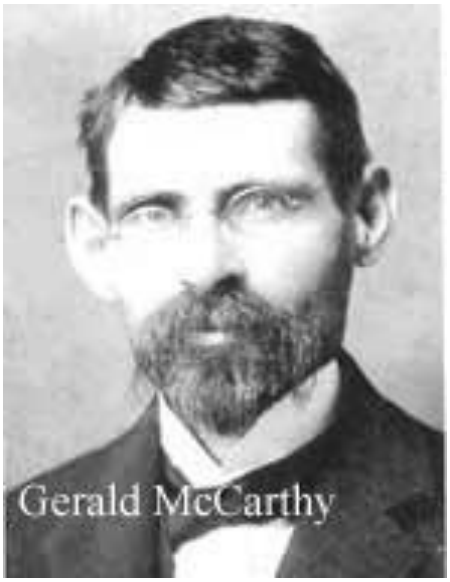

Figure 3. A portrait of Gerald McCarthy (Source: James R. Troyer's 1999 article) [16]

[16] (Available at: http://www.herbarium.unc.edu/Collectors/McCarthy_Gerald.htm)

McCarthy was deaf because of childhood meningitis [17] but was an active member of scientific circles at the time. For someone to write with such a deep appreciation of weeds, in 1892, is important because McCarthy objected strongly to Halsted's perfunctory listing species, such as clovers (*Trifolium* spp.), medics (*Medicago sativa*), vetches (*Vicia* spp.), and grasses, as *'wildlings of nature'* for which '*we have as yet found no important use*'. Calling this attitude foolish, he berated Halsted:

> *"…justice requires, in the case of plants and persons, everyone shall be innocent until they are proven guilty of wrong..."*

McCarthy was drawing on the famous '*innocent until proven guilty*' legal principle that entered the legal system in the USA in the mid-19th century [18].

His writing preceded the better-known reference, which established the principle in 1895 [19]. However, as Pennington (2003) explained, the principle is much older and can be traced back to the 13th century, used in defense of marginalized defendants, including heretics and witches. It is such an important legal maxim that the United Nations incorporated the principle in its *Declaration of Human Rights* in 1948 under Article 11, Section 1 (UN, 1948). The article reads as follows:

> *"…Everyone charged with a penal offence has the **right** to be presumed innocent until proved guilty according to law in a public trial at which he has had all the guarantees necessary for his defence..."*

The maxim also found a place in the European Convention for the Protection of Human Rights in 1953 as Article 6, Section 2 (ECHR, 1953). It was then additionally incorporated into the United Nations International Covenant on Civil and Political Rights as Article 14, Section 2 (CCPR, 1966).

In many countries, nowadays, the presumption of innocence is a legal right of the accused in a criminal trial. Under the presumption of innocence, the legal burden of proof is on the prosecution, which must present compelling evidence to a judge or a jury) to prove that the accused is guilty beyond reasonable doubt. If reasonable doubt remains, the accused must be acquitted.

Regrettably, this supreme legal principle has been reversed when it comes to colonizing taxa (weeds) and is used to summarily condemn and brand them as 'invasives'. Some commentators have taken this phrase to unjustified depths, maligning weeds as '*guilty, until proven innocent*' (see SOC, 2007). However, this viewpoint, taken by invasion biologists, along with the appropriateness of using fear-invoking terminology (viz. 'aliens', 'invaders', 'invasions') in public discourses on weeds has been questioned with vigour (see Davis and Thompson, 2001; Sagoff, 2005; Davis et al., 2011; Guiaşu and Tindale, 2018).

The reversal of the esteemed phrase of universal importance, so clearly enunciated for public good, is unwarranted, intellectually dishonest, and a form of populism at its worst. It is driven by the self-interest of the proponents in their push for one side of the argument (i.e., negative impacts of weeds, presented as a world at the cusp of an imminent 'invasion'). I doubt whether it has anything to do with a genuine interest in saving the world from marauding invaders, who, it is alleged, commit mass murder across continents, and crimes against nature!

As a botanist, Gerald McCarthy recognized two essential aspects of weeds: '*situations*' (interpreted as the occupation of vacant spaces) and '*inherent properties*' (heritable characteristics) of some taxa that could be hurtful to human interests. Perhaps, this writing inspired our discipline's founding fathers, such

[17] Dr. James R. Troyer's article on Gerald McCarthy (1999) , summarized by Carol Ann McCormick (2011), records that he was sacked from his job in 1897 as a result of departmental mergers and politics. The termination of his services has also been attributed to a claim that the 'physical infirmity prevented his being a teacher', although McCarthy had delivered numerous oral presentations and had interacted well with hearing persons. Troyer notes that McCarthy was not a research scientist despite holding many equivalent positions. For his enormous contributions to Botany, the Gallaudet University, a federally chartered private university in Washington D.C. for the education of the deaf and hard of hearing conferred upon McCarthy a D.Sc. in 1904.

[18] According to Gary Martin (The Phrase Finder), the phrase '*innocent until proven guilty*' was first cited as a legal principle in the *Law Reports of the Supreme Court of Ohio*, 1835. "The law presumes all innocent of crime until proven guilty" (see: **https://www.phrases.org.uk/meanings/innocent-until-proven-guilty.html**).

[19] Coffin v. United States, 156 U.S. 432 (1895), was an appellate case of the US Supreme Court. In this case, F.A. Coffin and P.B. Coffin were charged with aiding and abetting the President of the Indianapolis National Bank, Theodore P. Haughey, in misdemeanor and bank fraud. The Supreme Court's commentary led to the establishment of this legal principle (Source: **https://en.wikipedia.org/wiki/Presumption_of_innocence**).

as Herbert George Baker and Arthur Hugh Bunting, to describe 'situations' (viz. 'disturbed' environments and man-modified habitat) and 'characteristics and attributes' that define weedy taxa (Bunting, 1960; Baker, 1965 - see Baker's 'Ideal Weed').

McCarthy's reference to weeds as 'vegetable malefactors' was unfortunate, as these taxa do not commit a crime; nor do they intend to cause harm to anyone. Nevertheless, McCarthy, a much-underrated individual for his varied botanical accomplishments (see Troyer, 1999), is amongst the more enlightened biologists of the late-19th century, who saw weeds differently from farmers and agriculturists who disliked weeds intensely.

Along with Emerson, McCarthy must be recognized for challenging the intolerant views on weeds, which were prevalent at that time in the USA. The reasons why such alternative viewpoints did not get much traction and stalled in the 20th century also need further discussions within our discipline.

Weeds and 'Proto-weeds'

An understanding of the 'origins' of weeds must define what they are. Such an understanding comes from archaeo-botanical investigations of prehistoric sites where nomadic hunter-gatherers first trialled the growing of food crops. The area where systematic cultivation (viz. settled agriculture) first occurred is the 'fertile crescent'. It is a crescent-shaped region in the Middle East, which spans south-western Iraq (ancient Mesopotamia, between the rivers, Euphrates, and Tigris), south-eastern parts of Turkey (Anatolia) and the western fringes of Iran, Syria, Lebanon, Israel, Palestine, Jordan, and Egypt (Zeder, 2011).

The Middle East was home to some of the earliest known human civilizations. Archaeology shows that significant human populations roamed the region from around the last ice age (ca. 23,000 years ago), mostly as hunter-gatherers. The Neolithic period (the 'new stone age') is thought to have begun around 11,000 years ago in the Middle East. This period is marked by evidence of domestication of both animals and plants (i.e., settled agriculture), construction of shelters, and the manufacture of pottery and textiles. Thriving in this 'cradle of civilization', Neolithic people were both nomadic and hunter-gatherers before they settled.

Until now, the consensus of researchers has been that farming was 'invented' in the Neolithic period, possibly around 12,000-11,000 years BCE in the fertile crescent region. This view is challenged by some new findings by an international collaboration of researchers from Tel Aviv University, Harvard University, Bar-Ilan University, and the University of Haifa. This research discovered the first evidence that 'trial' plant cultivation began far earlier - some 23,000 years ago. The study (Nadel et al., 2004) described the discovery of the first weed species, named 'proto-weeds', at the site of a sedentary human camp on the shore of the Sea of Galilee.

The researches from the University of Haifa excavated Ohalo II, in 1989, during a drought that caused a drop in water levels in the Sea of Galilee (Lake Kinneret, Israel). However, when the drought abated and waters of the Sea of Galilee rose, the site became inaccessible, and work at Ohalo was halted for the next 10 years. When the water receded again, following several years of drought and intensive water pumping in the Jordan River, in 1999, the work re-commenced. The two main excavations at Ohalo II, located on the south-western shore of the Sea of Galilee, occurred during six seasons from 1989 to 1991 and from 1998 to 2001 (Nadel et al., 2004).

Because weeds thrive in cultivated fields and disturbed soils, a significant presence of weeds in archaeo-botanical assemblages at neolithic sites of a later age, could serve as an indicator of some form of systematic cultivation. The well-preserved material from the Ohalo II site, which had been submerged for millennia, has provided evidence for the first appearance of weeds, much earlier than the presumed dates of the beginning of agriculture. Below is an excerpt from Snir et al. (2015).

> *"…Weeds are currently present in a wide range of ecosystems worldwide. Although the beginning of their evolution is largely unknown, researchers assume that they developed in tandem with cultivation since the appearance of agricultural habitats some 12,000 years ago. These rapidly-evolving plants invaded the human disturbed areas and thrived in the new habitat..."*
>
> *"…Here we present unprecedented new findings of the presence of "proto-weeds" and small-scale trial cultivation in Ohalo II, a 23,000-year-old hunter-gatherers' sedentary camp on the shore of the Sea of Galilee, Israel. We examined the plant remains retrieved from the site (ca. 150,000 specimens), placing particular emphasis on the search for evidence of plant cultivation by Ohalo II people and the presence of weed species..."*

"…The archaeo-botanically-rich plant assemblage demonstrates extensive human gathering of over 140 plant species and food preparation by grinding wild wheat and barley. Among these, we identified 13 well-known current weeds mixed with numerous seeds of wild emmer, barley, and oat. This collection provides the earliest evidence of a human-disturbed environment, at least 11 millennia before the onset of agriculture, that provided the conditions for the development of "proto-weeds", a prerequisite for weed evolution…"

The Ohalo site was inhabited by hunter-gatherers during the Last Glacial Maximum (LGM) - 27,000 to 21,000 years ago when world-wide, glacial ice sheets reached a maximum, at ca. 23,000 years ago. The Ohalo findings support the view that the species we brand 'weeds' did not necessarily arise out of agriculture. These colonizing taxa evolved and existed millions of years before humans, and well before settled agriculture.

Weeds are typically regarded as synchronous with the domestication of plants and animals. Weeds are also considered as the unwanted, unconsciously selected reciprocals of intensive agriculture. The '*no man-no weed*' rhetoric is a much repeated theme within contemporary Weed Science (Young and Evans, 1976). The recent Ohalo II findings can be interpreted as indicative of agriculture not being a necessity for weeds to evolve. Agriculture, characterized by marked disturbances, would have expedited the successional species, who have the capacity to take possession quickly of vacant niches.

Species, branded as 'weeds' are simply colonizing taxa, which evolved well before humans to colonize vacant habitat wherever it existed (Chandrasena, 2019). Many such species then rapidly evolved to inhabit habitat associated with and disturbed by man. Given that the 2000 m^2 Ohalo' camp' site is dated back to 23,000 years ago, the evidence suggests that today's weeds, or their ancestors, were present in the region, at least 10,000 years before settled agriculture (Snir et al., 2015).

That several colonizing species may have been thriving around the ancient human settlements is no surprise. The study authors suggested that the species identified in the archaeo-botany studies were, perhaps, the fore-runners of the present day 'weedy' counterparts. My view is that agriculture was not a prerequisite for most weeds to evolve, although, there may be some exceptions. Associations with humans (selection pressure) may have influenced some colonizing taxa to evolve. These were most likely the species we find associated with agriculture today ('agrestal' weeds). The evolution of such species was expedited by the disturbances caused by agriculture.

The Ohalo excavations unearthed well-preserved plant matter amongst the remains of several small dwelling huts. There were also hearths outside the huts, human burial sites, as well as stone tools. The thousands of years old plant material offers clues as to how people lived during one of the coldest periods in recent human history - the last glacial period. These include material that had been used for building the huts and bedding. The plant material, initially preserved by charring and the sedimentation of silts, had been sealed in the low-oxygen conditions under the lake water. These conditions were ideal for preserving the organic material (Snir et al., 2015).

The species used for building the huts were thick branches of tamarisk (*Tamarix* sp.), willow (Salix sp.), and Mount Tabor oak (*Quercus ithaburensis*). These had been covered by smaller branches and leaves of other woody species, such as orach (*Atriplex* sp.) sedlitzia (*Sedlitzia* sp.) and mesquite (*Prosopis* sp.).

Apart from such woody colonizers, seeds of 13 current weed species were found among the ca. 150,000 identified charred seeds and fruits (Table 2). The weed seeds were mixed with grains of cereals, such as wild emmer wheat (*Triticum dicoccoides;* syn. *Triticum dicoccocum* Schrank), wild barley (*Hordeum spontaneum* (K. Koch) Thell.), and wild oat (*Avena barbata* Pott ex Link or *Avena sterilis* L.).

The high-frequency occurrence of weed seeds among the preserved seeds (~15,726 or 10.5%) reflects their common presence. Were they precursors of the modern-day weeds? Almost all the seeds (93.2%) belong to two important, current crop weeds: corn cleavers (*Galium tricornutum*), and darnel (*Lolium temulentum*).

Until now, the original habitat of these plants was unknown, as they are rare outside agricultural environments in the region. Ohalo II, therefore, provides the oldest known indication of their origin, as well as the time of their entrance into the human-made habitat. Some other species found at the site – common lambsquaters (*Chenopodium album*), mallow (*Malva parviflora*), Syrian thistle (*Notobasis syriaca*), and milkthistle (*Silybum marianum*) - are well-known weeds. They occur in the region, typically in disturbed areas or waste sites. However, some of their parts are edible and would have been eaten.

Table 1 Earliest weeds or 'proto-weeds' identified from archaeological studies of seeds at the Ohalo II pre-historic site (Source: Snir et al., 2015)

Species & Family	Common names and observations
Adonis dentata or *Adonis microcarpa* (Rannunculaceae)	phesant's eye; red chammomile; Eurasian weeds; now cosmopolitan.
Chenopodium album (Chenopodiaceae)	Fathen; common lamb's quarter; Eurasian weed; cultivated for millenia; now cosmoploitan.
Fumaria densiflora or *Fumaria parviflora Fumaria macrocarpa* (Fumariaceae)	Fumitory; several species; common Eurasian weeds; now cosmopolitan; known for medicinal uses.
Galium tricornutum (Rubiaceae)	Rough corn-cleavers; Eurasian weed; now cosmopolitan.
Lolium rigidum or Lolium multifloruma Lolium temulentum (Poaceae)	Ryegrass; many species; Eurasian weeds; now cosmopolitan; naturalized all over the world.
Malva parviflora or Malva aegyptiaca (Malvaceae)	small-flowered mallow, cheeseweed; or Egyptian mallow; Eurasian and North African weeds; now cosmopolitan.
Melilotus indicus (Fabaceae)	Sweet clover; sour clover; Eurasia and North African weeds; now cosmopolitan
Neslia apiculata (Berassicaceae)	Ball mustard; Eurasia and North African weeds; now cosmopolitan
Notobasis syriaca (Asteraceae)	Syrian thistle; Eurasian Weed; now cosmopolitan.
Silybum marianum (Asteraceae)	Milkthistle; European weed, now cosmopolitan; known for medicinal uses.

The presence of such a wide variety of weeds, particularly corn cleavers, indicate that these species might have been growing together with the wild cereals. It is possible that the inhabitants engaged in small-scale trial plot cultivation of cereals for food. It is also possible that the 'proto-weeds' may have been gathered in the wild or from a local dump area where they grew (Snir et al., 2015). Since these wild cereals and weeds currently grow in both cultivated fields, waste dumps and uncultivated regions of the Jordan Valley, both ideas are plausible.

Archaeological evidence from several locations appear to indicate that some nomadic hunter-gatherer human groups, who lived ca. 23,000 years ago, may have tried out a more sedentary life. Staying in one place, they might have engaged in elementary, cereal cultivation. Overall, the fortuitous findings at Ohalo II provide the earliest botanical evidence of a disturbed environment of an ancient permanent camp, around which today's weeds proliferated.

Research of the Paleolithic period has already demonstrated that humans may have caused significant modifications to their environments. This would have been long before the Neolithic revolution ca. 23,000 years ago. Ancient humans set fire to vegetation, hunted, and trapped preferred species of mammals, birds, reptiles, and fish. They also cut down trees for shelters, and to produce tools and objects. Small human populations of the past, conducting such activities, on a small-scale, cannot be considered as deforestation, in the sense the term is used today; it was merely part of their survival strategy. However, even small populations of humans would create waste, as well as waste dumping areas, in and around their habitations.

Later, while attempting to cultivate coarse and large-grained grasses, hunter-gatherers, transitioning to a more sedentary lifestyle, would have cleared areas near their dwellings for some basic planting. The disturbance of environments around camps would have led to the proliferation of species that follow humans and thrive alongside the obliging human ally (these are called synanthropic plants).

These plant species, both annuals, and perennials exhibit functional and adaptive traits that enable them to withstand the stresses of the disturbed habitats. By being successful, they would have increased their biological fitness in natural plant communities, altered by their ally, or natural forces.

Concluding comments

What the research confirms is that the relationship between weeds and men is an old one; weeds are *shadows of men*, as well as *shadows of man's history and manipulations of his environment*.

As Young and Evans (1976) foretold several decades ago, "*The introduction of colonizing species to new environments may be one of the greatest manipulations that the human agency is responsible for. The total consequences of such actions will be determined in the future*".

The most damaging impacts humans have on other organisms (biodiversity, including colonizing taxa) come from the large-scale land clearing to grow monocultures of crops, deforestation for timber, land reclamation and drainage of wetlands for uses, such as agriculture, mining, and urban growth. The relentless mining for coal, minerals, oil, and gas, and large infrastructure projects, such as the oil and gas pipelines, also cause damages to landscapes on a scale hitherto unknown to the planet.

In the meantime, a deeper ecological and historical understanding of how, why, and where weeds have come about would help modify our attitudes, allowing us to avoid creating conflicts with potentially useful plant taxa and getting into situations from which we cannot win.

As photosynthetic organisms, colonizing taxa are critical biological resources. We may have to depend on them in times to come. As part of Nature's rich biodiversity, all that weeds are doing is to take the opportunity, when presented, to grow, survive, and reproduce. In 1859, Charles Darwin called this a 'struggle for existence' which is the title of Chapter 3 (p. 66) of his *'On the Origin of Species'*.

Darwin mentioned weeds in Chapter 3 and stressed the vital role of competition among organisms in driving forward natural selection and biological evolution. Colonizing taxa (weeds) will often win in 'struggles for existence' with other species because they are adapted by millions of years of evolution to do so. In so doing, they are perpetually engaged in the biological conservation of their identity and kind. *Isn't that what all successful organisms are supposed to do?*

Finally, to conclude this Editorial, I wish to highlight some sentiments expressed by Robert Zimdahl, which I echo (Zimdahl, 2010, preface, p. xi):

> *"...Understanding the past and knowing where we came from is essential to interpretation of the present and exploration of routes to the future…"*
>
> *"…How I evaluate that history, however, reflects my judgments based on years of thought and study. I have tried to think like others and have listened to the stories of many concerning the development of weed science..."*

Although not a trained historian, I am interested in the historical communications, past events, and occurrences that defined *Weed Science*, before it became the formidable scientific discipline it is today. Interpreting and analyzing history, drawing out actual or potential, explicit, or implicit meanings, is a worthwhile endeavour. However, interpretations and the likely conclusions need to be logical, well-informed, and supported by chronicles, documents, diaries, letters, official archives, all of which constitute proper research.

As George Santayana (1852-1953), a Spanish-born, US philosopher (Santayana, 1906, p. 284) said:

> *"…Those who cannot remember the past are condemned to repeat it..."*

In my view, the new generation of weed scientists would benefit from rigorous examination of past documents, which record meaningful and worthy activities of our science's founders, related to botany, weeds, and agriculture.

I emphasize that knowledge of history is intelligible only to those who are prepared by education, technique, and attitude to ask the right questions and listen for the answers.

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