THE COMMERCIAL SEED TRADE: AN EARLY DISPERSER OF WEEDS IN THE UNITED STATES[1]

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Mack, Richard N. (Department of Botany, Washington State University, Pullman, WA 99164). THE COMMERCIAL SEED TRADE: AN EARLY DISPERSER OF WEEDS IN THE UNITED STATES. *Economic Botany 45(2):257–273. 1991. Seeds, bulbs, and cuttings of exotic plant species, including plants cultivated exclusively as ornamentals, were being advertised for sale in printed circulars in the United States by 1800. By the end of the 19th century seed trade catalogs were prolific and often listed dozens of exotic species that were already naturalized in the U.S. or new introductions from foreign suppliers. Among the species routinely offered for sale were many now considered noxious (e.g.,* Berberis vulgaris, Eichhornia crassipes, Isatis tinctoria*) or at least undesirable (e.g.,* Cannabis sativa, Eleusine indica, Lysimachia nummularia*). This commerce was not only responsible for the introduction and spread of some species earlier than previously recognized (e.g.,* Bryonia alba, Schinus terebinthifolius*) but also caused the deliberate distribution of other species assumed to have been spread by accident alone (e.g.,* Aegilops cylindrica, Bromus briziformis, Bromus mollis*). Seedsmen's introduction of substantial genetic variation through repeated introductions, inadvertent directional selection for local races in their gardens, their widespread use of seeds (compared to cuttings or non-fertile plant material), and the sowing of seeds at high density under cultivation all enhanced the opportunity for eventual naturalizations. The largely unrecognized proliferation of this industry in the 19th century and the ready access that consumers had to these species via mail order contributed to the rapid and extensive dissemination of at least 139 alien species throughout the United States.*

Der Samenhandel: ein frühen Verbreiter von Unkräutern in den Vereinigten Staaten. *Samen, Zwiebeln, und Stecklinge von exotischen Pflanzenarten, inklusive Pflanzen, die man ausschliesslich als Zierpflanzen kultivierte, wurden schon um 1800 durch Rundschreiben in den USA zum Verkauf angeboten. Zum Ende des 19. Jahrhunderts waren Samenhandelskataloge weitverbeitet und fuehrten oft Dutzende von exotischen Arten, die sich schon in den USA heimisch gemacht hatten, oder neues Material von auslaendischen Lieferanten. Unter den Arten, die ueblicherweise zum Verkauf angeboten wurden, befanden sich nun viele, die heute als schaedlich (z.B.* Berberis vulgaris, Eichhornia crassipes, Isatis tinctoria*) oder wenigstens als unerwuenscht (z.B.* Cannabis sativa, Eleusine indica, Lysimachia nummularia*) angesehen werden. Dieser Handel war nicht nur verantwortlich fuer die Einfuerung und Verbreitung mancher Arten zu einem frueheren Zeitpunkt als bisher vermutet (z.B.* Bryonia alba, Schinus terebinthifolius*), sondern verursachte ebenso die absichtliche Verbreitung anderer Arten, von denen man annahm, dass sie lediglich durch Zufall verbreitet wurden (z.B.* Aegilops cylindrica, Bromus briziformis, Bromus mollis*). Der Anstoss zu wesentlicher genetischer Variation durch wiederholte Einfuhr durch Samenhaendler, unbeabsichtigte natuerliche Auslese von lokalen Arten in ihren Gaerten, der weitverbreiteter Gebrauch von Samen (im Gegensatz zu Stecklingen oder anderen Arten der vegetativen Vermehrung), sowie dem dichten Saeen von Samen im Anbau, dies alles erhoehte die Gelegenheit zur schliesslicher Naturalisierung. Die weitgehend unerkannte Ausbreitung dieser Industrie im 19. Jahrhundert und der leichte Zugang, den Kunden zu diesen Pflanzenarten per Postversand hatten, trugen zur raschen und ausgedehnten Verbreitung von mindestens 139 fremden Arten in den ganzen USA bei.*

The growth and spread of the alien flora in the United States have long been the subject of intense practical observation (De Schweinitz 1836; Dewey 1897; Forcella and Harvey 1983; Robbins 1940): as early as the 1600's observers were noting the entry and naturalization of plants into North America (Cronon 1983 and references therein). Successive editions of local floras covering approximately the same area are among the best documentation we have of both the tim-

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ing and growth of this alien flora. For instance, Darlington (1918) compared the weed species—which were almost all aliens—in successive floras of Michigan from 1839 to 1915. In less than 100 yr this flora grew from 47 to 147 species, with the fastest rate of introduction in the last quarter of the 19th century. Similarly rapid increases in alien floras can be traced in the successive editions of floras of eastern Washington (Mack 1986) and central Illinois (Myers and Henry 1979).

Such compilations prompt obvious questions dealing first with the circumstances surrounding the introduction of these species into the conterminous U.S. and then the means of their spread within the continental interior. Alien plants have arrived in the U.S. by many agents, ranging from accidental immigrations in ship ballast along coastlines to deliberate introductions by private groups and governmental agencies (e.g., Mack 1986; Ridley 1930; Southern California Acclimatizing Association 1895; Williams 1980). Accidentally introduced plants have spread at radically different rates as packing material, as disseminules attached to animals, and in feces (Dewey 1897; Ridley 1930), and most importantly as contaminants in the seed lots of crops (Mack 1986). The spread of deliberately introduced plants has been equally diverse. Plants in this category have served medicinal or herbal purposes, as forage, and especially as ornamentals. Muenscher (1955) compiled a list of plants that he believed had been introduced for these reasons, and many of these species (e.g., *Artemisia absinthium* L., *Lonicera japonica* Thunb., *Rumex acetosa* L., *Tanacetum vulgare* L.) now commonly appear in regional floras throughout the U.S.

The mode by which these plants and others were deliberately disseminated is often unclear. For instance, was the spread of *Nepeta cataria* L. or *Marrubium vulgare* L., both common medicinal plants of the 19th century, attributable simply to the haphazard transfer of seeds from one person to another? This mechanism acting alone has never seemed an entirely plausible explanation, given the speed with which many alien plants spread throughout the U.S. For example, *Eichhornia crassipes* (Mart.) Solms. had spread to all southeastern states by 1900, even though it was unreported in the U.S. before 1884 (Penfound and Earle 1948). I document here another, largely unrecognized agent that accounts for much of the introduction and spread of many alien plants once deemed useful but now considered pestiferous—the 19th century commercial seed trade.

The Seed Catalogs Examined

The documentation I examined consists of pre-1900 seed catalogs within the extensive Nursery and Seed Trade Catalogs Collection at the National Agricultural Library (NAL) and within the Department of Special Collections at the University of California (Davis). For this paper I examined all pre-1872 catalogs in the NAL collection, plus all catalogs for a selection of years spanning the rest of the 19th century: 1875, 1880, 1883, 1885, 1886, 1888, 1890, 1895, and 1899. Examination of the pre-1900 holdings at UC (Davis) was less systematic. Table 1 represents species listed in at least one catalog that are now naturalized in the U.S.; Tables 2 and 3 compile records for alien species that failed to become naturalized and some prominent native species included in these catalogs, respectively.

Several attributes of these catalogs allow their use as records of alien plant availability and spread. Since merchants revised their catalogs annually, each catalog's year of publication is clearly indicated. Unlike most of their modern counterparts, almost all these pre-1900 catalogs list each species by both scientific and common names. To avoid matching unknown or obscure nomenclature to modern taxon names, I usually tallied only species for which the scientific name has remained unchanged and is listed in Fernald (1950) or another North American flora. Alternative or disputed names are noted in Table 1. I assumed that *Ailanthus glandulosa* = *A. altissima* (Mill.) Swingle, *Pontederia crassipes* = *Eichhornia crassipes, Pontederia azurea* = *Eichhornia azurea* (Sw.) Kunth., and *Pueraria thunbergiana* = *P. lobata* (Willd.) Ohwi. I also included in the tally species for which there was an obvious misspelling of a name that has remained unchanged, e.g., *Sorghum halapense* (L.) Pers. [sic].

Interpretations from these records were guided by the following points. Any collection of such archival material is a highly biased record of the past. For example, the majority of the catalogs in the NAL collection are from Massachusetts, New York, and Pennsylvania. While both the earliest and the largest number of 19th century seedsmen likely resided in these states, the Midwest, West and especially the South are certainly

underrepresented in my compilation. Unknown is how many other seedsmen printed catalogs during the 19th century; also unknown is the original source of the plant material and any quantifiable records of the locations to which seeds were mailed. I have avoided drawing conclusions from negative evidence: i.e., the lack or infrequency of a species in these catalogs does not accurately gauge its commercial availability in the 19th century. Most important is my assumption that the seeds, cuttings, etc. were correctly identified.

Growth of the Seed Trade Industry in the United States: pre-1865

Circulars and pamphlets advertising seeds, cuttings, bulbs, and tubers were in circulation in the U.S. by at least the last quarter of the 18th century; the oldest record in the NAL is a fruit tree catalog from the William Prince Nursery in Flushing, New York, dated 1771. Not surprisingly, these early catalogs offer primarily a limited selection of crop plants. By 1800 much more extensive catalogs were available in which lists reached several hundred species, including the seeds of ornamental plants and species used in medicine or for seasonings. Among these early 19th century catalogs are the first records of species that are today naturalized in the U.S.: *Amaranthus retroflexus* L. and *Mimosa pudica* L. (catalog of Bernard M'Mahon, Philadelphia, 1804).

John Bartram & Son, early American naturalists, maintained a nursery at Philadelphia from which they advertised in 1807 a much more extensive collection than M'Mahon's. Included among their listing of "trees, shrubs, and herbaceous plants, indigenous to the United States of America. . ." were alien species, including *Lysimachia punctata* L., *Ricinus communis* L., *Rumex acetosella* L., and *Solanum nigrum* L. Correctly listed as alien species were *Artemisia absinthium* L., *Artemisia vulgaris* L., *Rhamnus cathartica* L., *Solanum dulcamara* L., and *Ulex europaeus* L. The Bartram's catalog is intriguing for several reasons. It includes 55 species available at Philadelphia at the beginning of the 19th century that had already or were to become naturalized in the U.S., including *Cannabis sativa* L., *Centaurea cyanus* L., and *Hyoscyamus niger* L. For several of these (*Anthemis cotula* L., *Lamium amplexicaule* L., *Lolium temulentum* L., *Papaver dubium* L., *Tragopogon porrifolius* L., *Verbascum thapsus* L.), the only record that I have found of their sale in the U.S. is Bartram's catalog. Yet, each species has become naturalized in widely separated parts of the U.S.

The diversity of alien species sold after 1820 increased substantially. Bartram's Botanic Garden catalog for 1828 offered a long list of "medicinal and culinary" species, including such aliens as *Arctium lappa* L., *Digitalis purpurea* L., *Euphorbia lathyris* L., *Hesperis matronalis* L., *Isatis tinctoria* L., *M. vulgare,* and *N. cataria.* All these species are now naturalized in the U.S. *Isatis tinctoria,* dyer's woad, is the most serious pest in this group for it is now rapidly spreading in northern Utah and southeastern Idaho (Callihan et al. 1984; Farah et al. 1988). Other now naturalized species sold in the eastern U.S. before 1850 (with the earliest seed catalog record of their sale in parentheses) are *Papaver somniferum* L. (John B. Russell, Boston, 1828), the aggressive *Agrostemma githago* L. (Hovey & Co.'s, Boston, 1845), *Tamarix gallica* L. (W. Prince, Flushing, New York, 1823), the now widespread *Lonicera japonica* (W. Prince, Flushing, New York, 1823), *Cytisus scoparius* (L.) Link (W. Prince, Flushing, New York, 1844–1845), and *Cyperus esculentus* L. (W. Prince, Flushing, New York, 1829).

Growth of the Seed Trade Industry in the United States: post-1865

Any chronological division of the 19th century seed trade is necessarily subjective, but I have chosen to divide these records with the end of the American Civil War. After 1865 the volume and extent of rail traffic and consequently the size of seedsmen's potential markets increased markedly (U.S. Bureau of the Census 1895). Information in seed catalogs supports the use of the mid-1860's as an appropriate time line. Catalogs in circulation in the late 18th and the first half of the 19th century suggest that markets were small: seeds, etc. could be shipped but, more commonly, instructions in the catalogs indicate that customers made their purchases at the seed house or nursery. Potential markets expanded as postal rates for printed matter repeatedly fell between 1845 and 1852 (Roper 1917). Not only could circulars be inexpensively mailed hundreds of miles, but the orders could also be filled by mail or rail freight. By 1875 seedsmen routinely enclosed order forms in their catalogs, and

most sales for the larger businesses would have occurred by mail. Soon many seedsmen were clearly catering to a regional or even national market. For example, seedsmen in New York, La Crosse, Wisconsin and Philadelphia sold *Atriplex semibaccata* R. Br., a native of Australia, with statements in their advertising that this species did well in arid western environments. The inclusion of species in these catalogs for markets hundreds or even thousands of miles away is also seen for other species, including *Eucalyptus globulus* Labill. (catalog of D. M. Ferry & Co., Detroit, Michigan, 1880) and *Grevillea robusta* A. Cunn. (catalog of Alfred Bridgeman, New York, 1899). One indirect gauge of the size of these markets is provided by the testimonials of satisfied customers. It is common to find a seedsman from, say, Georgia, reprinting correspondence received from throughout the eastern third of the U.S., or even the U.K. Well before 1900 some American seedsmen had become international as well as national traffickers in living plant material.

This trade had, of course, long operated in both directions across the Atlantic, and the European seed trade had a sustained influence on the seed trade industry in the U.S. and the species sold. Most of the new ornamental varieties in each year's catalogs were clearly indicated as imports from Europe. Many British and German firms sold thousands of species through catalogs. For instance, the 1868 catalog of Haage & Schmidt (Erfurt, Germany) listed 12,471 taxa, including such unlikely commercial species as *Bromus tectorum* L. By importing plants from European firms, U.S. seedsmen were drawing on immense collections. As a result, some seedsmen began producing catalogs that were several hundred pages long; a few annually produced half a dozen catalogs, each specializing in one part of the burgeoning seed trade (e.g., Peter Henderson & Co's., New York, 1890). By 1899 hundreds of firms operated in the northeastern U.S. alone, many annually producing catalogs adorned with elaborate multi-colored prints of the plants they sold (see Mack 1990).

The Diversity of Weedy Alien Species Sold by 1900

Of the hundreds of alien species sold in the 19th century, comparatively few have become naturalized in the U.S. Table 1 tallies those 139 naturalized taxa sold from 1804 to 1899 for which the species' names have remained unchanged. Many species within this list, such as *Briza maxima* L. and *Marrubium vulgare*, present little or no environmental threat. Others (e.g., *Lysimachia punctata, Tanacetum vulgare*) are frequently nuisances and locally persistent but not particularly aggressive. The remaining list comprises some of the worst weeds found in the U.S. today (e.g., *Berberis vulgaris* L., *Eichhornia crassipes, Sorghum halepense*), including one species on the Federal Noxious Weed List, *Eichhornia azurea* (Westbrooks 1981). As a group they illustrate the diversity of ornamental, forage, and medicinal plants available before 1900.

The importation and sale of alien graminoids for forage has been practiced in the U.S. for at least 3 centuries: Cronon (1983) reported that a routine commerce was established in southern New England by the 1640's in the seeds of "English grasses"—probably species such as *Poa pratensis* L. My concern here is with a sedge and a grass that were first sold for forage production. Some of the worst weeds are sedges in the genus *Cyperus* (Holm et al. 1977). *Cyperus esculentus*, yellow nut-grass, is a perennial tuber-bearing sedge native to the Old World (Godfrey and Wooten 1979). In addition to being a serious pest in tropical Africa, the species includes ecotypes that infest crops in the southeastern U.S. (Holm et al. 1977). Seedsmen may have played only a minor role in the spread of yellow nut-grass in the U.S.; I found only one supplier who sold *Cyperus esculentus* (W. Prince, Flushing, New York), and this firm sold it for only about a decade before 1840. But even a short commercial history may have been sufficient to establish the foci for the sedge's later spread.

Sorghum halepense (Johnson grass), one of the most troublesome alien plants in the U.S., has a much more extensive commercial history. This perennial grass displays both high fecundity and vigorous vegetative growth. In addition, it is an aggressive competitor and difficult to eradicate (Holm et al. 1977). More serious is its ability to introgress with commercial sorghum thereby producing commercially useless offspring called shattercane (Baker 1972). Johnson grass is one of the few wild species that might produce offspring more "weedy" than itself through hybridization with a domesticated transgenic relative (NAS 1989). McWhorter (1971) argued that *S. halepense* was probably in the U.S. by 1830. He pointed out that its early history in North Amer-

Table 1. Species now naturalized in the U.S. that were sold as seeds or occasionally as cuttings in 19th century seed catalogs along with chronological listing of the number of seedsmen in each state who were selling the species (in parentheses). An asterisk (*) refers to a seed catalog in the University of California (Davis) Special Collections; all others are in the Nursery and Seed Trade Catalog Collection of the National Agricultural Library. Nomenclature and naturalized status of the species are according to references cited with superscripts; information for species without superscripts is according to Fernald (1950). Alternative names that reflect more modern taxonomic treatment are listed in the footnotes.

Catalog Date	Seedsman Location
Acacia decurrens (J. Wendl.) Willd.	
1844/45	PA
1886	CA
1890	CA; FL
1895	CA
1898/99	CA
1899	CA
Acacia melanoxylon R. Br.	
1886	CA
1890	CA
1895	CA
1898/99	CA
1899	CA (2)
Achillea ptarmica L.	
1825	NY
1826	NY
1828	PA
1843	NY
1845/46	NY
1846	MA
1846/47	OH
1853	ME
1875	NY
1885	MA; NY
1888	MA
1889/90	NY
1890	NY
Acorus calamus L.	
1826	NY
1827	DC
1828	PA
Aegilops cylindrica L.	
1866	MA
1870	NY
1871	NY (2)
1875	NY
1880	NY
1883	NY
1886	NY
Agrostemma githago L.	
1845	MA
1847	MA
1851	MA
Ailanthus altissima (Mill.) Swingle	
1823	NY
1826	NY
1828	PA
1829	NY
1831	NY
1833	MA (2)
1841	NY
1843	NY
1844/45	NY; PA
A. altissima (Continued)	
1845	NY; OH; PA
1845/46	NY
1846/47	NY; OH
1848	OH
1848/49	NY
1850/51	MA
1855	MA
1859/60	IL; PA
1867	PA
1869	NY; OH
1875	NY (3)
1880	NY
1883	NY
1884	CA*
1885	MA (2); MD; NY
1886	MA; NY
1888	MA (2); NY; PA
1890	CA; MA; NY (6); PA (3)
1894/95	CA*
1899	IN; MA; NC; NY (4); OH; WI
Albizzia julibrissin Durazzini	
1890	FL
Amaranthus retroflexus L.	
1804	PA
1807	PA

Table 1 (Continued)

Catalog Date	Seedsman Location
B. vulgaris (Continued)	
1845	NY
1845/46	NY
1846/47	NY; OH
1848	OH
1848/49	NY
1850/51	MA
1855	MA
1859/60	IL; PA
1867	PA
1869	NY; OH
1875	NY (3)
1880	NY
1883	NY
1884	CA*
1885	MA (2); MD; NY
1886	MA; NY
1888	MA (2); NY; PA
1890	CA; MA; NY (6); PA (3)
1894/95	CA*
1899	IN; MA; NC; NY (4); OH; WI
Borago officinalis L.	
1807	PA
1825	NY
1826	NY
1827	NY
1828	MA; PA
1829	NY
1836	MA
1838	MA
1840	MA
1841	NY
1843	DC
1846	MA
1875	NY
B. officinalis (Continued)	
1895	MI
Briza maxima L.	
1836	MA
1838	MA
1840	MA
1845	MA
1847	NY
1852	NY
1859	MA
1860	MA
1868	MI*; PA
1869	MA (2); NY
1870	NY (2); OH
1871	MI*; NY (2)
1875	NY (2)
1880	NY
1883	IL; NY; PA
1885	MI*
1888	NY
1890	MI*; PA
1895	MI*
1899	MI*
Briza media L.	
1869	MA
1870	NY
1883	IL; NY
Bromus briziformis Fisher & Mey	
1869	PA
1871	NY (2)
1875	NY (3); NY*; PA
1876	NY*
1877	NY*
B. briziformis (Continued)	
1880	MA; NY (2); OH; PA
1883	IL; MA; NY; PA
1885	DC; MA (2); NY (3)
1888	MA; NY (2); PA (2)
1889/90	NY
1890	MA (2); NY (3); PA (3)
1894/95	CA*
1895	IL; NJ*; NY; NY*
1899	NY
Bromus madritensis L.	
1883	IL; NY
1890	MA; NY
Bromus mollis L.[k]	
1883	IL*; NY
1885	NY
1890	NY
1895	NY
1899	NY; WI
Bromus secalinus L.	
1899	OR
Bromus sterilis L.	
1883	IL; NY*

Table 1 (Continued)

Catalog Date	Seedsman Location
Anchusa officinalis L.	
1825	NY
1826	NY
1827	NY
1828	PA
1829	NY
1843	DC
Anthemis cotula L.	
1807	PA
Anthemis nobilis L.[i]	
1825	NY
1826	NY
1827	NY; DC
1828	PA
1829	NY
1833	MA
1834/35	MA
1841	NY
1843	DC
1844/45	NY
1846	MA
1852	NY
Anthemis tinctoria L.	
1895	NJ
Arctium lappa L.	
1807	PA
1825	NY
1826	NY
1827	DC; NY
1828	PA
1834/35	MA
1843	DC
Artemisia absinthium L.	
1807	PA
1825	NY
1826	NY; PA
1827	DC; NY
1828	PA
1829	NY
1833	MA
1834/34	MA
1841	NY
1843	DC
1859	RI*
1874	NJ*
1875	NY (2); NY*
1880	PA
1885	MA (2); MI*; NY
1888	MA (2)
1890	IA; LA; MI*; NY (2)
1895	MI*; NJ*
1899	MI*
Artemisia vulgaris L.	
1807	PA
1875	NY
1880	NY
1890	NY
Asperula odorata L.[j]	
1883	NY
1890	PA
1895	NY
1899	NY
Atriplex semibaccata R. Br.	
1899	CA; NY; PA; WI
Atropa belladonna L.[b]	
1825	NY
1826	NY
1827	NY
1829	NY
1833	MA
1834/35	MA
1841	NY
1875	NY (2)
1885	MA; NY
1890	NY
Bellis perennis L.	
1807	PA
1826	NY
1828	PA
1829	NY
1831	NY
1833	MA
1841	NY
1844/45	NY
1860	MA
1862	MA
1866	MA
1867	MA
1868	MI*
1869	MA; NY (2) PA
1870	NY
1874	MI*; NJ*
1875	NY*
1877	NY*
1885	NY
1890	IA; LA; MA; NY; PA
1899	NY*; OR
Berberis vulgaris L.	
1841	NY (2)
1843	NY (2)
1844/45	NY

Table 1 (Continued)

Catalog Date	Seedsman Location
Bryonia alba L.[h]	
1860	MA
1862	MA
1866	MA
1867	MA
1870	NY
1871	NY
1889/90	NY
1899	IL; NY
Cannabis sativa L.	
1807	PA
1825	NY
1826	MD
1827	NY
1834/35	MA
1835	OH
1845	MA
1847	NY
1852	NY
1868	MI*
1870	NY
1871	MI*
1874	MI*; NJ*
1875	MI; NY*; NY (2)
1880	MI*; PA
1883	NY
1885	MI*; NY
1888	MI; PA
1890	NY (2)
1895	MI*
1899	MI
Casuarina equisetifolia Forst.[c]	
1825	NY
1830	NY
1832	NY
1844/45	PA
1871/72	CA*
C. equisetifolia (Continued)	
1887/88	FL
1890	FL
1892	FL*
1894/95	CA*
1898/99	CA
Casuarina glauca Sieb.[c]	
1890	FL
1892	FL*
Casuarina stricta Dry. in Ait.[f]	
1844/45	PA
1866	MA
1867	MA
1871/72	CA*
1874	CA*
1882	CA*
1887/88	FL
Centaurea cyanus L.	
1807	PA
1827	NY
1834/35	MA
1835	OH
1838	MA
1840	MA
1842	MA
1845	MA
1847	NY (2)
1852	NY
1859	MA
1860	MA
1862	MA
1863	NY
1866	MA
1867	MA
1868	MI*
C. cyanus (Continued)	
1869	MA (3); NY (2)
1870	NY (2); MA
1871	MI*
1874	MI*; NJ*
1875	GA; MI; NY*; NY (3)
1876	NY*
1877	NY*
1880	LA; MA (2); ME; MI*; NY (3)
1883	GA; IL; MA; NY; PA
1885	DC; MA (2); MI*; NY (2)
1888	CA; LA; MA; MI; NY (2); OH; PA
1890	CA (2); LA; MA (4); MI*; NY (4); OR; PA (5)
1895	MI*; NJ*
1899	MI*; NY*
Centaurea macrocephala Puschk.[g]	
1869	MA
1880	NY
Centaurea moschata L.	
1827	NY
1834/35	MA
1835	OH
1838	MA
1842	MA
1845	MA
1847	NY

Table 1 (Continued)

Catalog Date	Seedsman Location
C. moschata (Continued)	
1852	NY
1854	MA
1862	PA
1863	PA; NY
1866	NY
1869	NY (3); PA
1870	NY
1889	PA*
1894	PA*
Centaurea nigra L.	
1833	MA
1841	NY
1844/45	NY
1845/46	NY
Cerastium tomentosum L.	
1870	NY
Chenopodium botrys L.[d]	
1807	PA
1827	NY
1834/35	MA
1843	DC
Conium maculatum L.	
1807	PA
1825	NY
1826	NY
1828	PA
1829	NY
1831	NY
1874	NJ*
1875	NY*; NY (2)

Catalog Date	Seedsman Location
C. maculatum (Continued)	
1883	NY
1885	NY
1890	NY
Convolvulus arvensis L.[b]	
1807	PA
1831	NY
Convolvulus sepium L.[d,l]	
1826	NY
1829	NY
1831	NY
1835/36	NY
1839	NY
Crotalaria retusa L.	
1899	FL; IA
Cynara cardunculus L.[d]	
1825	NY
1826	NY
1828	PA;
1829	NY
1831	NY
Cynodon dactylon (L.) Pers.	
1887/88	FL
1890	CA; FL; LA; NY (2); OR; PA
1892	FL*
1895	CA (2)

Catalog Date	Seedsman Location
C. dactylon (Continued)	
1899	CA (2); OH; OR; WA
Cyperus esculentus L.	
1829	NY
1831	NY
1839	NY
Cytisus scoparius (L.) Link	
1844/45	NY
1845	NY (2)
1846/47	NY; OH
1847	NY
1848	OH
1852	NY (2)
1861	NJ
1863	NY
1869	NY
1871/72	CA*
1885	MD
Dactylis glomerata L.	
1826	MD
1835	OH
1845	MA
1870	NY
1875	NY*; NY (2);
1877	NY*
1885	NY
1888	LA; PA (2)
1890	IA; LA; MA; NY (2); PA (3)

Table 1 (Continued)

Catalog Date	Seedsman Location
Eucalyptus globulus Labill.[d]	
1871/72	CA*
1874	CA* (2)
1875	NY
1875/76	FL*
1880	MI*
1882	CA*
1883	MA
1884	CA*
1886	CA
1890	CA*; CA (2); NY; PA
1894/95	CA*
1895	NY*
1898/99	CA
1899	CA (4); OR; WA
Eucalyptus polyanthemos Schauer.[d]	
1898/99	CA
Eucalyptus teriticornis Sm.[d]	
1898/99	CA
1899	CA
Euphorbia cyparissias L.	
1833	MA
1841	NY
1844/45	NY
Euphorbia lathyris L.[d]	
1807	PA
1825	NY
1826	NY

Catalog Date	Seedsman Location
E. lathyris (Continued)	
1828	PA
1829	NY
1835	OH
1847	NY
1852	NY
1859	RI
Festuca ovina L.	
1869	MA
1870	NY
1875	NY (2)
1885	NY
1886	NY; PA
1888	PA
1890	NY (2)
Gypsophila paniculata L.	
1847	NY
1855	MA*
1862	PA
1863	PA
1869	NY
1871	NY
1874	MA*
1875	NY (3)
1880	LA; MA (2); NJ; NY (3); PA
1883	IL; NY
1884	RI*
1885	MA (3); NY (3)
1888	CA; LA; MA (2); OH; NY; PA (2)
1889/90	NY

Catalog Date	Seedsman Location
G. paniculata (Continued)	
1890	CA; LA; MA (3); NY (4); OR; PA (4)
Grevillea robusta *A.* Cunn.[f]	
1871/72	CA*
1874	CA*
1882	CA*
1886	CA
1889/90	NY
1890	CA (2); FL; PA
1892	FL*
1899	FL; NY; PA
Hedychium gardneri-anum Roscoe[f]	
1844/45	PA
1866	MA
1887/88	FL
1889/90	NY
1890	FL
1892	FL*
Hesperis matronalis L.	
1811	PA
1825	NY
1826	NY; PA
1828	PA
1829	NY
1833	MA (2)
1835	OH
1838	MA
1840	MA
1841	NY

Table 1 (Continued)

Catalog Date	Seedsman Location
Digitalis purpurea L.	
1807	PA
1811	PA
1825	NY
1826	NY; PA
1827	NY
1828	PA
1829	NY
1833	MA
1834/35	MA
1835	MA; OH
1838	MA
1840	MA
1841	NY
1842	MA
1843	DC
1844/45	PA
1845	MA
1845/46	NY
1846	MA
1846/47	OH
1847	NY
1848	OH
1852	NY
1853	NY
1854	MA
1859	MA; RI*
1860	MA
1862/63	NB
1863	NY
1866	MA
1867	MA
1869	MA (2); NY (2)
1870	MA; NY
1875	NY (3)
1877	NY*
1880	MA (2); NY (2); PA
1883	IL*; NY*
1885	MA; NY
1888	NY
1889/90	NY
1890	MA; NY; PA

Catalog Date	Seedsman Location
Dipsacus sylvestris Huds.[m]	
1825	NY
1826	NY
1828	PA
1829	NY
1831	NY
Echinochloa colonum (L.) Link	
1870	NY
1871	NY
1875	NY
1880	NY
1883	NY
Echinops sphaerocephalus L.	
1807	PA
1826	PA
1835	MA
1836	MA
1852	NY
Echium plantagineum L.[d]	
1847	NY
1899	MA; PA
Eichhornia azurea (Sw.) Kunth.[n]	
1884/85	NJ
1890	PA
1892	FL*
1893	FL*
1895	NJ
1899	PA

Catalog Date	Seedsman Location
Eichhornia crassipes (Mart.) Solms.[a]	
1884/85	NJ
1888	PA
1889/90	NY
1890	FL; PA (2)
1892	FL*
1893	FL*
1894	NY*
1895	CA; FL; NJ*; NJ; NY
1899	CA; FL (2); IA; KY; MA; NY (2); PA; WI (2)
Eleusine indica (L.) Gaertn.	
1866	MA
1868	IL
1869	MA (3)
1880	MA
1883	NY
1885	NY
1886	NY
1890	NY
1899	NY
Elymus caput-medusae L.[d,n]	
1866	MA
Erodium cicutarium (L.) L'Her.	
1888	MA
1894/95	CA*
1899	CO
1899	CA

Table 1 (Continued)

Catalog Date	Seedsman Location
H. matronalis (Continued)	
1842	MA
1844/45	NY
1845	MA
1845/46	NY (2)
1846	MA
1846/47	OH
1847	NY (2)
1852	NY
1854	MA
1859	MA
1860	MA
1862	MA
1868	PA
1869	MA; NY; PA
1895	MI*
Hieracium aurantiacum L.	
1875	NY
1880	NY
Hyoscyamus niger L.	
1807	PA
1825	NY
1826	NY; PA
1827	NY
1828	PA
1833	MA
1834/35	MA
1841	NY
1843	DC
1846	MA
1852	NY
1859	RI*
1866	MA
1874	NJ*

Catalog Date	Seedsman Location
H. niger (Continued)	
1875	NY (2)
1885	NY
1890	NY
1895	NJ*
Hypericum perforatum L.	
1858	GA
1899	MA
Hyssopus officinalis L.	
1807	PA
1825	NY
1826	NY; PA
1827	NY
1828	PA
1829	NY
1833	MA
1834/35	MA
1841	NY
1843	DC
1846	MA
1852	NY
1875	NY
1890	IA; NY
1895	MI
Inula helenium L.	
1807	PA
1811	PA
1825	NY
1826	NY; PA
1827	DC; NY
1828	PA
1829	NY
1833	MA
1834/35	MA

Catalog Date	Seedsman Location
I. helenium (Continued)	
1841	NY
1843	DC
1852	NY
Ipomoea coccinea L.	
1804	PA
1807	PA
1827	NY
1834/35	MA
1835	OH
1838	MA
1840	MA
1842	MA
1845	MA
1847	NY (2)
1852	NY
1853	NY
1854	MA
1859	MA
1860	MA
1862	MA
1863	NY; PA
1866	MA
1868	PA
1869	PA
1870	NY
1875	MI; NY (2); PA
1880	MA (2); NY (4); PA
1883	MA
1885	DC; MA (3); NY (4);
1888	KY; MA; NY; PA
1890	FL; MA (2); NY (4); PA (3)

Table 1 (Continued)

Catalog Date	Seedsman Location
Ipomoea quamoclit L.	
1804	PA
1807	PA
1810	MD
1834/35	MA
1835	OH
1838	MA
1840	MA
1842	MA
1845	MA
1847	NY (2)
1852	NY
1853	NY
1854	MA
1859	MA
1862	NY
1863	NY; PA
1866	MA
1869	NY; PA
1870	NY (3)
1875	NY (3)
1880	LA; MA (2); ME (2); NY (4)
1883	MA
1885	MA; NY (2)
1888	PA
1890	FL; MA; NY (3)
Isatis tinctoria L.	
1807	PA
1825	NY (2)
1826	MD; NY
1827	NY
1828	MA; PA
1829	NY
1831	NY
1833	MA
1834/35	MA
1843	DC
1847	NY

Catalog Date	Seedsman Location
Kochia scoparia (L.) Roth	
1847	NY
1852	NY
1886	NY
1890	NY
Lamium amplexicaule L.	
1807	PA
Lantana camara L.[c]	
1804	PA
1826	PA
1828	PA
1830	NY
1852/53	NY
1858	IL
1862	NY
Lespedeza striata (Thunb.) H. & A.	
1888	LA
1890	LA; NY (2); PA (2)
Linaria dalmatica (L.) Mill.	
1899	CO
Lolium temulentum L.	
1807	PA

Catalog Date	Seedsman Location
Lonicera japonica Thunb.	
1823	NY
1825	NY
1826	PA
1828	PA
1832	NY
1844/45	PA
1845	PA
1845/46	NY
1846/47	NY; OH
1847	NY
1848/49	NY
1849	PA
1850/51	MA
1852	NY
1855	MA
1858	GA
1861	GA
1871	MO; PA
1874	CA*
1875	NY
1875/76	FL*
1880	NY
1888	AL; PA
1889/90	FL*
1890	NY (2)
Lychnis alba Mill.[o]	
1831	NY
1839	NY
1843	NY
1847	NY
1852	NY
1859	MA
1862	MA; NY; PA
1863	NY
1866	MA
1868	PA
1869	MA (2); NY
1870	MA; NY
1876	NY*

Table 1 (Continued)

Catalog Date	Seedsman Location
Medicago lupulina L.	
1807	PA
1826	MD
1834/35	MA
1847	NY
1852	NY
1875	NY
1886	PA
1888	PA
1890	NY (2)
Melia azedarach L.[d]	
1807	PA
1810	MD
1811	PA
1824	PA
1826	NY; PA
1828	PA
1831	NY
1833	MA
1841	NY
1847	NJ
1848	NJ
1862	MA
1869	MA
1875	NY
1882	CA*
1887/88	FL
1890	CA; FL (2); NY (2)
Melissa officinalis L.	
1807	PA
1825	NY
1826	NY
1827	DC
1828	PA
1829	NY
1843	DC
1875	NY
1895	MI

Catalog Date	Seedsman Location
Mesembryanthemum crystallinum L.[d]	
1807	PA
1811	PA
1824	PA
1826	PA
1827	NY
1828	PA
1834/35	MA
1835	OH
1838	MA
1840	MA
1842	MA
1845	MA
1847	NY (2)
1851	MA
1852	NY
1859	MA
1860	MA
1862	MA
1863	NY
1866	MA; NY
1867	MA
1868	PA
1869	MA (3); NY (2); PA
1870	NY (2); OH
1871	NY
1875	MI
Mimosa pudica L.[f]	
1804	PA
1807	PA
1835	OH
1836	MA
1838	MA
1845	MA
1847	NY
1866	MA
1867	MA
1868	IL; MI*
1869	MA; NY

Catalog Date	Seedsman Location
M. pudica (Continued)	
1871	MI*; NY
1875	NY
1880	MA
1885	MA; NY (2)
1886	PA
1887/88	FL
1888	LA; NY (2); OH; PA
1890	NY
1899	MA; NY*
Myrica faya Ait.[f]	
1825	NY
1826	PA
1830	NY
1832	NY
Nepeta cataria L.	
1807	PA
1825	NY (2)
1826	NY
1827	DC; NY
1828	MA; PA
1834/35	MA
1841	NY
1843	DC
1852	NY
1859	RI*
1875	NY*; NY
1885	MA; MI*; NY
1888	MA
1890	CA; NY (2); OR
1895	MI*; NJ*
1899	MI*; OR

Table 1 (Continued)

Catalog Date	Seedsman Location
L. alba (Continued)	
1877	NY*
1880	NY
1885	NY
1888	MA*; MA
1890	MA; NY; PA
1895	NY*
1899	MA
Lychnis chalcedonica L.	
1807	PA
1811	PA
1824	PA
1826	NY; PA
1827	NY
1828	PA
1831	NY
1833	MA
1841	NY
1843	NY
1844/45	NY (2); PA
1845	OH
1845/46	NY
1846	MA
1846/47	OH
1847	NY
1848	OH
1852	NY
1853	ME
1854	MA
1859	MA
1860	MA
1862	MA; NY; PA
1863	NY; PA
1866	MA; NY
1867	MA
1868	PA
1869	MA (2); NY (5); PA
1870	MA; NY (2); OH

Catalog Date	Seedsman Location
Lychnis dioica L.[p]	
1807	PA
1829	NY
1831	NY
1839	NY
Lychnis flos-cuculi L.	
1831	NY
1833	MA (2)
1835/36	NY
1839	NY
1841	NY
1844/45	NY (2)
1845/46	NY
1846	MA
1846/47	OH
1848	OH
1853	ME
1869	NY
Lysimachia nummularia L.	
1833	MA
1841	MA
1843	NY
1844/45	NY
1854	MA
1859	MA
1869	NY
1870	OH
1874	NJ*
1875	NY; OH; RI*
1880	NJ; NY
1885	MA
1886	NY
1888	DC; KY; MA
1890	NJ; NY
1891	NJ*
1893	NJ
1899	WI

Catalog Date	Seedsman Location
Lysimachia punctata L.	
1807	PA
1888	MA*
Lythrum salicaria L.	
1829	NY
1831	NY
1833	MA
1835	OH
1841	NY
1844/45	NY
1845	MA
Malva rotundifolia L.[q]	
1807	PA
Marrubium vulgare L.	
1807	PA
1825	NY
1826	NY; PA
1827	DC
1827	NY
1828	MA; PA
1829	NY
1833	MA
1834/35	MA
1841	NY
1843	DC
1852	NY
1868	MI*
1874	NJ*
1875	NY*; NY (2)
1880	NY; PA
1883	IL*; NY*
1885	MA; MI*; NY
1890	IA; MI*; NY (2)
1895	MI*; NJ*
1899	MI*; OR

Table 1 (Continued)

Catalog Date	Seedsman Location
Panicum maximum Jacq.[a]	
1890	FL
Papaver dubium L.	
1807	PA
Papaver rhoeas L.	
1807	PA
1822	NY (2)
1834/35	MA
1847	NY
1870	NY
1875	NY*; NY (2)
1880	MI*; PA
1883	NY
1885	MI*; NY
1888	MI; PA
1890	NY (2)
Papaver somniferum L.	
1828	MA
1827	NY
1834/35	MA
1835	MA
1835	OH
1838	MA
1840	MA
1842	MA
1843	DC
1847	NY
1852	NY
1854	MA
1863	NY; PA
1869	MA
1870	NY
1874	NJ*

Catalog Date	Seedsman Location
P. somniferum (Continued)	
1875	NY*; NY (3)
1880	LA; NY; PA
1883	NY; PA
1884	NY*
1890	LA; NY
Pennisetum setaceum (Forsk.) Chiov.	
1883	NY
Pennisetum villosum R. Br.[d]	
1853	NY
1859	MA
1860	MA
1890	NY
1899	NY
Phalaris canariensis L.	
1807	PA
1826	MD
1834/35	MA
1835	OH
1847	NY
1852	NY
1870	NY
1874	NJ*
1875	NY*; NY (2)
1880	MI*; PA
1883	IL; NY (2)
1885	MI*; NY
1888	PA
1890	NY

Catalog Date	Seedsman Location
Plantago lanceolata L.	
1890	NY
Plantago major L.	
1807	PA
Poa compressa L.	
1899	TX
1899	NY (2); OR; PA; VA; WI
Portulaca oleracea L.	
1807	PA
1875	NY*
Potentilla argentea L.	
1807	PA
Psidium cattleianum Sabine[f]	
1832	NY
1844/45	PA
1845	MA
1871/72	CA*
1887/88	FL
1889/90	FL*; NY
1890	FL (2)
1892	FL*
1899	FL
Pueraria lobata (Willd.) Ohwi	
1895/96	CA
1899	FL

Table 1 (Continued)

Catalog Date	Seedsman Location
Ranunculus acris L.	
1826	NY
1829	NY
1831	NY
1841	NY
1844/45	NY
1845/46	NY (2)
1846	MA
Rhamnus cathartica L.	
1807	PA
1826	NY; PA
1828	PA
1829	NY
1831	NY
1833	MA
1841	NY
1843	NY
1844/45	NY (2)
1845	NY
1845/46	NY
1846/47	NY; OH
1850/51	MA
1855	MA
1869	MA
1875	NY (2)
1882	CA*
1883	NY
1884	CA*
1885	MA; MD
1888	MA; NY
1890	MA; NY (3); PA (2)
1899	IN; NY (3)
Ricinus communis L.	
1807	PA
1834/35	MA
1843	DC
1852	NY
1866	MA

Catalog Date	Seedsman Location
R. communis (Continued)	
1870	NY (2); OH
1874	NJ*
1875	NY*; NY (2)
1876	NY*
1880	MA; ME; NY (3)
1883	IL; NY
1884	NY*
1885	MA; NY
1887/88	FL
1890	FL; MA; NY
Rosa multiflora Thunb.	
1826	PA
1828	PA
1849	PA
1852	NY
Rumex acetosella L.	
1807	PA
Rumex crispus L.	
1807	PA
1888	MA
Rumex obtusifolius L.	
1807	PA
Ruta graveolens L.	
1807	PA
1825	NY
1827	DC; NY

Catalog Date	Seedsman Location
R. graveolens (Continued)	
1829	NY
1841	NY
1843	DC
1846	MA
1852	NY
1875	NY
1895	MI*
Saponaria officinalis L.	
1807	PA
1811	PA
1826	NY; PA
1829	NY
1831	NY
1833	MA
1839	NY
1841	NY
1844/45	NY; PA
1859	MA; RI*
1889/90	NY
Schinus molle L.[d]	
1832	NY
1838	PA
1844/45	PA
1868	IL
1869	MA
1874	CA*
1880	MA
1882	CA*
1890	CA
1899	CA; NY
Schinus terebinthifolius Raddi[e]	
1832	NY
1899	CA

Table 1 (Continued)

Catalog Date	Seedsman Location
T. vulgare (Continued)	
1885	MA; MI*; NY
1890	MI*; NY (2)
1895	MI*; NJ*
1899	MI*
Taraxacum officinale Weber	
1895	MI*
Tragopogon porrifolius L.	
1807	PA
Tussilago farfara L.	
1807	PA
1825	NY
1827	DC
1829	NY
1841	NY (2)
Ulex europaeus L.	
1807	PA
1823	NY
1825	NY
1827	NY
1828	MA; PA
1829	NY
1831	NY
1832	NY
1833	MA
1841	NY
1843	NY
1844/45	PA
1845/46	NY
1846/47	NY
1847	NJ; NY

Table 1 (Continued)

Catalog Date	Seedsman Location
Ulex europaeus L.	
1848	NJ
1852	NY
1885	MD
1890	NY; PA
1894/95	CA*
1899	CA; NY
Verbascum thapsus L.	
1807	PA
Xanthium strumarium L.	
1807	PA

[a] Correll and Johnston (1970)
[b] Hitchcock *et al.* (1959)
[c] Long and Lakela (1971)
[d] Munz (1959)
[e] Munz (1974)
[f] Neal (1965)
[g] Roche and Talbot (1986)
[h] Welch *et al.* (1987)
[i] equals *Chamaemelum nobile* (L.) All. (Tutin *et al.* 1976)
[j] equals *Galium odoratum* (L.) Scop. (Tutin *et al.* 1976)
[k] equals *Bromus hordeaceus* L. subsp. *hordeaceus* (Tutin *et al.* 1980)
[l] equals *Calystegia sepium* (L.) R. Br. (Tutin *et al.* 1972)
[m] equals *Dipsacus fullonum* L. (Tutin *et al.* 1976)
[n] equals *Taeniatherum caput-medusae* (L.) Nevski (Tutin *et al.* 1980)
[o] equals *Silene latifolia* Poiret subsp. *alba* (Miller) Greuter & Burdet (Clapham *et al.* 1987)
[p] equals *Silene dioica* (L.) Clairv. (Clapham *et al.* 1987)
[q] equals *Malva pusilla* Sm. (Tutin *et al.* 1968)

Table 1 (Continued)

Catalog Date	Seedsman Location
Solanum dulcamara L.	
1807	PA
1826	PA
1828	PA
1829	NY
1833	MA
1841	NY
1844/45	NY
1845	NY
Solanum nigrum L.	
1807	PA
Sorghum halepense (L.) Pers.	
1883	LA
1883	IL; NY
1885	MI*; NY
1886	LA; NY (3); PA (2)
1888	LA; MI; NY; PA (2)
1890	CA; LA; MI*; NY (2); OR; PA (2)
1894/95	CA*
1895	GA; MI*
1899	CA (4); GA; LA; MO (2); NB; NY (5); OH; OR (2); PA (2); VA; WA WI (2);

Catalog Date	Seedsman Location
Spergula arvensis L.	
1885	NY
1890	NY
1894/95	CA*
1895	MI*
1899	CA; IL (2); MA; MI; NY (2)
Tamarix africana Poir.[e]	
1852	NJ; NY
1853	ME
1855	MA
1856	CA*; NY
1858	VA
1859/60	PA
1861	NJ
1869	NY
1874	CA* (2)
1880	NY
1882	CA*
1884	CA*
1885	MD
1886	TX
1888	NY; PA; UT
1889/90	NY
1890	NY (3); PA
1899	NJ; NY (5); NY*
Tamarix gallica L.[d]	
1823	NY
1826	NY
1828	PA
1829	NY
1831	NY
1833	MA (2)
1841	NY
1843	NY

Catalog Date	Seedsman Location
T. gallica (Continued)	
1844/45	NY
1845	NY (2); PA
1845/46	NY (2)
1847	NJ
1848	NJ
1848/49	NY
1849	PA
1850/51	MA
1852	NJ; NY
1856	CA*; NY
1859	RI*
1869	NY
1871/72	CA*
1875	NY
1886	MA
1888	MA
1889/90	NY
1890	NY (2)
1899	NJ; NY (2)
Tamarix tetrandra Pall.[d]	
1875	NY
1888	NY; PA
1890	NY
1899	NJ
Tanacetum vulgare L.	
1807	PA
1825	NY (2)
1827	DC
1827	NY
1828	MA
1829	NY
1833	MA
1841	NY
1852	NY
1874	NJ*
1875	NY*; NY (2)
1880	PA

ica is clouded by the number of common and scientific names under which it has been known. Consequently, its seeds may have been sold early in the 19th century under various pseudonyms, but the earliest reference that I have seen to "*Sorghum halepense*" in seed catalogs appeared in 1883 (catalog of R. Frotscher, New Orleans). It was commonly sold for the remainder of the century throughout the U.S. (Table 1). Even while being touted as a productive forage grass, some seedsmen (e.g., catalog of R. Frotscher, New Orleans, 1886) were cautioning their customers not to sow Johnson grass near cultivated fields, as "It is almost impossible to get it out of land." One seed firm, Johnson & Musser of Los Angeles, California, stated in its 1899 catalog that, "It is so difficult to eradicate from soil when once established that we do not recommend it," but they nevertheless sold the grass.

Grasses were also widely sold in the late 19th century for use in "immortelles," i.e., dried flower arrangements and wreaths. While the use of dried grasses as ornamentals is common today, the choice of species that filled Victorian vases often proved unwise. *Aegilops cylindrica* L., jointed goat grass, was among the worst. This

grass is a serious weed in cereal fields in the central Great Plains and the Pacific Northwest (Donald 1980; Swan 1984) because it is related to wheat, thus complicating the use of some herbicides. Furthermore, there remains the unresolved possibility that *A. cylindrica* can hybridize with wheat to produce fertile hybrids (Swan 1984). So far, the danger from such introgression however appears small (A. Ogg, personal communication). Another ornamental grass of that era, *Eleusine indica* (L.) Gaertn. (goose grass) is a major pest worldwide (Holm et al. 1977). In southeastern U.S. it commonly infests fields of cotton, peanuts, and sorghum (Elmore 1984). The dried inflorescences of at least five alien annual bromes (*Bromus briziformis* Fisher. & Mey., *B. madritensis* L., *B. mollis* L., *B. secalinus* L., and *B. sterilis* L.) were also considered of ornamental value. All of these bromes are common weeds of cereal fields, and they may be locally prominent. *Bromus mollis* is a prevalent alien brome in the Central Valley of California, and *B. secalinus* and *B. sterilis* are widespread in the U.S. (Muenscher 1955). Other weedy alien grasses sold as ornamentals include *Elymus caput-medusae* L. and *Briza minor* L. The marketing of these grasses illustrates that some alien plants owe their spread to purposes for which they have long since been discarded. It would be difficult if not impossible today to detect the impetus for their original dissemination were their early use not so clearly indicated in 19th century seed catalogs.

The largest single group in Table 1 is herbaceous dicots. Most were distributed as ornamentals; the rest were used for medicine or seasonings. No one species completely characterizes this diverse group, although the historical use and spread of *Centaurea cyanus* (cornflower, bachelor's button) is instructive. This annual composite was available commercially by at least 1807. According to Bailey (1914), it became one of the most popular garden plants in the U.S., probably because of its variably colored corollas (blue, purple, pink, or white), plus its ability to flower until frost. Another trait that Bailey noted—the ability to set seed in autumn and emerge in the spring with little or no cultivation—has contributed to its role as a weed. This ability and a wide ecological amplitude have allowed cornflower to become one of the most widely distributed alien plants in the U.S.; it is commonly found along roadsides, agricultural fields, and other sites of continual disturbance (Fernald 1950; Hitchcock et al. 1955; Munz 1959; Radford et al. 1968; Steyermark 1963). Unlike most other species in Table 1, cornflower is still available commercially.

Medicinal plants were sold throughout the 19th century, although they were probably most common in pre-1865 catalogs; plants such as *Papaver somniferum* (opium poppy) and *Cannabis sativa* (hemp) were included. To the 19th century seedsman and his customers, *C. sativa,* was a multipurpose plant for which different varieties were sold; one variety for hemp or fiber production; another variety for the production of oil (seeds). These varieties (and others designated in the 19th century) do not deserve separate taxonomic status, as these products can be produced from any *C. sativa* (Schultes 1970). Haney and Bazzaz (1970) maintained that naturalized *C. sativa* resulted from plants cultivated for fiber or oil; naturalizations could have also resulted from uneaten bird seed, another common use for which hemp seeds were widely sold at that time (catalogs of R. H. Allen & Co., New York, 1870 and B. K. Bliss & Sons, New York, 1883). There is no evidence in U.S. seed catalogs that hemp was sold in the 19th century to produce its well-known cannabinoids. As Schultes (1970) proposed, the explanation may lie in the widespread belief at that time that only hemp grown in India produced pharmaceuticals.

Some of the most damaging and persistent weeds are aquatic vascular plants (Holm et al. 1969). In addition to competing with native submerged plants for light, they may grow so vigorously as to block navigable waterways and may even provide habitat for the insect vectors of malaria and encephalomyelitis (Holm et al. 1977; Vietmeyer 1975). Unfortunately, some of the worst aquatic plants were sold as ornamentals in the U.S. in the 19th century, including both *Eichhornia azurea* and *E. crassipes* and almost certainly *Myriophyllum brasiliense* Camb. (termed *M. proserpinacoides* in most 19th century catalogs).

Information provided by seed catalogs on the introduction of *Eichhornia crassipes* (water-hyacinth) into the U.S. is particularly revealing. Heretofore the accepted account of water-hyacinth's entry begins with its display at the Cotton Centennial Exhibition in New Orleans in 1884. This attractive aquatic plant was handed out at the exhibition and presumably the attendees dispersed the plant locally—an account ap-

parently first given by Klorer (1909) and reiterated since then (Barrett 1989; Penfound and Earle 1948; Sculthorpe 1967). But water-hyacinth was available as *Pontederia crassipes* by at least 1884 from the catalog of Edmund D. Sturtevant of Bordentown, New Jersey. Furthermore, the plant was available from the German firm Haage & Schmidt repeatedly in the 20 yr preceding the Cotton Exhibition. How much these two early sources may have contributed to its spread in the U.S. is unknown. But the plant soon attracted the attention of many other U.S. nurserymen: by 1888 it was being sold by Henry A. Dreer in Philadelphia, one of America's largest seed houses. By 1895 it was being extolled with much purple prose by seedsmen as widely separated as New York, Florida, and California (Table 1).

Given the environmental damage water-hyacinth was soon to wreak on the lower Mississippi drainage and elsewhere (Sculthorpe 1967), the advice in some of these catalogs to grow the plant outdoors in pools is chilling (catalog of John L. Childs, Floral Park, New York, 1895). As with *Sorghum halepense,* apocalyptic statements were sometimes voiced about the dangers of disseminating the plant, but the advice was already too late. For example, the Royal Palm Nurseries (Oneco, Florida) matter-of-factly stated in its advertisement for water-hyacinth for 1899 that it, "Has proved to be a nuisance in Florida rivers and lakes, forming large masses and obstructing navigation." That assessment was an understatement; by 1897 water-hyacinth was becoming a major navigation hazard on several rivers in Florida (Webber 1897), compelling Congress to provide funds to combat it (U.S. Congress. House. 55th Cong., 3rd sess., 1899, H. Doc. 91). Consequently, the 19th century closed with an expanding list of merchants actively selling water-hyacinth, while the federal government was actively seeking its control.

With the exception of edible gourds and grapes, viney species were sold principally as ornamentals in the 19th century (e.g., *Hedera helix* L., *Wisteria sinensis* Sweet). Most of these ornamental vines have not become weedy in the U.S., although two vines have become naturalized pests (Table 1). Unlike many of the other cucurbits sold in the latter half of the 19th century, *Bryonia alba* L. produces neither an edible nor a showy pepo [cf. *Echinocystis lobata* (Michx.) T. & G.]. Preparations from *Bryonia* fruits have been used since antiquity as emetics and cathartics in southern Europe (Hamilton 1852), although the plant appears to have been sold in the U.S. only for its ornamental value. Despite repeated sales in the 19th century, this perennial vine apparently failed to become naturalized in most of the U.S. However, in the last 25 yr or more it has spread in southeastern Idaho, Montana, northern Utah, and especially southeastern Washington (Dorn 1984; R. N. Mack, personal observations; Welch et al. 1987). I do not know whether these current invasions of *B. alba* stem from introductions made long ago by commercial seedsmen, although it may not be coincidental that at one site in Cache Co., Utah, *B. alba* was found in a long-abandoned garden with other ornamental cucurbits (R. Alan Black, personal communication).

In autumn 1876 the U.S. Centennial Commission took the farsighted action of appointing a committee to inspect the Philadelphia site of the recently concluded international exhibition for insects and plants that had been introduced as a result of the foreign exhibits. The committee was diligent to a fault; they delayed reporting until 5 yr later, "in the belief that some solitary plants might be overlooked, which producing seed and increasing in following seasons, might then be discovered by their greater numbers" (LeConte et al. 1881). Despite their diligence, the five person committee could not have known at the time that a deliberate plant introduction would become the most serious pest resulting from the Exhibition, kudzu (*Pueraria lobata*). According to the catalog of the Jessamine Gardens (Florida) for 1899, the plant was introduced at the Exhibition's Japanese exposition. Kudzu may have entered the commercial nursery market soon thereafter as several nurseries in the early 1880's offered vaguely described vines that might have been kudzu. The earliest reliable catalog record I have seen of its sale in the U.S. is by H. H. Berger (San Francisco) in 1895. Whether this supplier had acquired stock from the original 1876 introduction is unresolvable. But by the last decade of the 19th century additional material was being exported directly from Japan by several nurseries (F. Takaghi, Tokyo, 1894, 1897, 1898; Yokohama Nursery Co. Ltd, Yokohoma, 1898). Consequently, the last decade of the 19th century saw entries of kudzu into the U.S. from Japan that all pre-date introductions of the vine by the U.S.D.A. (cf. Anonymous 1905).

Certainly the worst woody plant widely sold by 19th century seedsmen is *Berberis vulgaris,* the intermediate host of the wheat rust fungus *Puccinia graminis.* This European shrub was being sold in the U.S. by at least 1841, and it was commonly sold in the northeastern U.S. by 1899. Given its availability in the 19th century, it is not surprising that its eradication during World War I would require a massive effort employing thousands of workers and even school children (Hutton 1928). Other introduced shrubs, while less pestiferous than *B. vulgaris,* have nevertheless become invasive. *Rhamnus cathartica,* the English buckthorn, is locally a serious weed in the Midwest (Leitner 1985). *Cytisus scoparius,* Scotch broom, and *Ulex europaeus,* gorse, were sold early in the 19th century; for instance, gorse was sold at the Bartram's garden by 1807. Although the popularity of Scotch broom seems to have waned after the American Civil War, gorse was still sold in 1899. The history of dissemination of Japanese honeysuckle, *Lonicera japonica,* is confused because loniceras were sold under varietal names much earlier in the 19th century than most other woody ornamentals. Listings in Table 1 are restricted to only those records specifically designated as "*Lonicera japonica.*" But the number of vendors selling the shrub under myriad varietal names was likely much larger.

Few alien trees have become serious weeds in the U.S., although most of these species were sold by 19th century seedsmen and nurserymen. Apparently tamarisks, such as *Tamarix africana* Poir. and *T. gallica* were popular lawn trees even before 1865 (e.g., catalogs of William Prince, Flushing, New York, 1823 and Thomas Hancock, Burlington, New Jersey, 1852). Tamarisks sold under one or more names have become serious plant invaders along waterways, especially in the American Southwest (Christensen 1962; Robinson 1965). As a group these species reputedly act as phreatophytes and may detrimentally alter salt concentrations on the soil surface (Hem 1967; van Hylckama 1974).

Most 19th century seedsmen and nurserymen resided in the northeastern quarter of the country, yet they actively sold several semi-tropical or tropical trees that became serious weeds in the southern U.S. and Hawaii, including *Casuarina equisetifolia* Forst., *Psidium cattleyanum* Sabine, and *Schinus terebinthifolius* Raddi. *Schinus terebinthifolius,* Brazilian-pepper, was sold as an ornamental tree. With its bright red fruits and waxy leaves it has gained wide acceptance in Hawaii and Florida as a Christmastide substitute for holly (Morton 1978). Morton (1978) surmised that Brazilian-pepper was first introduced into the U.S. at the turn of this century by the Plant Introduction Service. But this tree was sold over 60 yr earlier in New York (Table 1), and it seems unlikely that even the seeds advertised in the Park Nursery catalog (Pasadena, California) for 1899 were derived from the Plant Introduction Service. Brazilian-pepper possesses features that have facilitated its spread, ensured its persistence, and prompted the concern for its control. Its fruits are commonly spread by frugivorous birds; in the Everglades birds carry the invader to remote hammocks from which it is difficult to remove. As a result, it may now be the most serious plant invader in the Everglades (Toops 1979). In addition, its stems and fruits produce a variety of compounds that cause respiratory problems and contact dermatitis in humans (Morton 1978). *Psidium cattleyanum* (strawberry guava), along with *S. terebinthifolius,* was sold as early as 1832 as both an ornamental and for fruit production. *Casuarina equisetifolia* was also sold beginning early in the 19th century for the shade provided by its unusual foliage of minute, whorled leaves.

Species That Have Failed to Become Naturalized

Although my emphasis has been on exotic species that became naturalized through their sale in seed catalogs, many other species were repeatedly introduced but have so far failed to spread outside cultivation. Explanations for many of these failures in naturalization are straightforward: e.g., the species lack tolerance to frost, herbivory, or competition in the new locale; or they reproduce infrequently and irregularly.

The failure of other species introduced repeatedly in the 19th century is not as readily explained (Table 2). A small grass, *Lagurus ovatus* L., was commonly sold for immortelles from 1875 onward because of its attractive panicle. Yet it only sparingly escapes cultivation in the U.S. (Hitchcock 1951). It has however become naturalized elsewhere, such as Cape Province in South Africa (personal observation). *Agrostis nebulosa* Boiss. & Reut. was widely sold for the same purpose and has also failed to become naturalized. Other species in this group represent

interesting parallels with a more successful congener. Both *Bryonia alba* and its congener *B. dioica* Jacq. are vines that die back each winter to a perennial rootstock and produce fleshy, animal-dispersed fruits. Yet only *B. alba* has become invasive in the U.S.

Few of the many eucalypts and acacias introduced into California from Australia have become naturalized: *E. globulus, E. polyanthemos* Schauer., *E. teriticornis* Sm. (Table 1). At least 19 others, including *E. leucoxylon* F. Muell., *E. maculata* Hook., *E. robusta* Sm., and *E. saligna* Sm., and five acacias [*A. armata* R. Br. in Ait., *A. dealbata* Link, *A. floribunda* (Vent.) Willd., *A. pycnantha* Benth. in Hook., and *A. suaveolens* (Sm.) Willd.] were repeatedly introduced but do not persist outside cultivation (Table 2). In contrast, some of these unsuccessful immigrants to the U.S. have become invasive weeds in South Africa (e.g., *A. pycnantha, A. dealbata*) (Stirton 1983; von Breitenbach 1989) in communities that are similar to the chaparral of California.

Species that fail to become naturalized in the U.S. despite repeated opportunities are potentially powerful tools for unraveling the causes for plant invasions. Experimental comparisons of naturalized species with these "failed aliens" could separate those plant characters that contributed to naturalization compared to those that were merely coincidental. Comparisons among closely-related congeners may be among the most straightforward experimental pairings (Groves 1986), but even a species without an invasive relative represents a decipherable array of traits that singly or collectively precluded its establishment in a new range. Whether plant invasions are simply idiosyncratic and therefore unpredictable events (Crawley 1987), or whether future invasions can be predicted with knowledge of the interactions between the arrays of an immigrant's characters, the features of its new environment, and the circumstances of entry cannot be resolved until we thoroughly examine the species that succeed and those that repeatedly fail in the same new range. The voluminous records provided by these catalogs provide a heretofore unutilized resource in the selection of this experimental material.

Range Expansion of Native Species via the Seed Trade

Seedsmen and nurserymen did not restrict their trade to alien species; as a result, the ranges of

Table 2. Alien species sold in the 19th century that do not or rarely persist outside cultivation in the U.S. Superscripts refer to authorities for nomenclature; species without superscripts are according to Willis (1972). Alternative names that reflect more modern taxonomic treatment are listed in the footnotes.

Catalog Date	Seedsman Location
Acacia armata R. Br. in Ait.	
1824	PA
1826	PA
1852	NY
1862	MA
1869	MA (2)
1898/99	CA
Acacia dealbata Link	
1852	NY
1862	MA
1869	MA (2); NY (2)
1898/99	CA
Acacia floribunda (Vent.) Willd.	
1860	MA
1866	MA
1867	MA
1886	CA
1895	CA
1899	CA (2)
1898/99	CA
Acacia pycnantha Benth. in Hook.	
1886	CA
1898/99	CA
Acacia suaveolens (Sm.) Willd.	
1826	PA
1844/45	PA
1898/99	CA
Agrostis nebulosa Boiss. & Reuter[d]	
1860	MA
1869	NY
1870	NY
1875	NY
1880	ME; MI; OH
1882	IN
1883	IL; NY
1884	NY; RI
1885	MA
1887	IN
1888	NY
1890	CA; MI; OR
1893	NJ
1894	IL
1894/95	CA
1895	MI; NJ
1899	OR
Avena sterilis L.[d]	
1866	MA
1871	NY (2)
1875	NY
Briza minor L.[c]	
1871	MI
1883	IL; NY
Bryonia dioica L.[a,e]	
1875	NY
1883	NY
1899	IL; NY
Eucalyptus eugenioides Sieber ex Spreng[b]	
1886	CA
Eucalyptus goniocalyx F. Muell. ex Miq.[b]	
1886	CA
1898/99	CA
Eucalyptus haemastoma Sm.[b]	
1886	CA
1898/99	CA
Eucalyptus leucoxylon F. Muell.	
1895	CA
1898/99	CA
1899	CA (3)
Eucalyptus longifolia Link[b]	
1898/99	CA
1899	CA
Eucalyptus macrorhyncha F. Muell. ex Benth.	
1886	CA
Eucalyptus maculata Hook.	
1898/99	CA
Eucalyptus melliodora A. Cunn. ex Schauer[b]	
1886	CA
1898/99	CA

Table 2 (Continued)

Catalog Date	Seedsman Location
Eucalyptus obliqua L'Herit.	
1886	CA
1895	CA
1898/99	CA
1899	CA (2)
Eucalyptus paniculata Sm.[b]	
1898/99	CA
1899	CA
Eucalyptus pilularis Sm.[b]	
1886	CA
1898/99	CA
Eucalyptus piperita Sm.[b]	
1886	CA
1895	CA
1898/99	CA
1899	CA
Eucalyptus regnans F. Muell.	
1898/99	CA
Eucalyptus resinifera Sm.[b]	
1895	CA
1898/99	CA
1899	CA (2)
Eucalyptus robusta Sm.[b]	
1895	CA
1898/99	CA
1899	CA (3)
Eucalyptus saligna Sm.[b]	
1895	CA
1898/99	CA
1899	CA
Eucalyptus siderophloia Benth.[b]	
1886	CA
1895	CA
1898/99	CA
1899	CA (2)
Eucalyptus stricta Sieber ex Spreng.	
1886	CA
Eucalyptus viminalis Labill.[b]	
1898/99	CA
1899	CA
Hakea gibbosa Cav.[b]	
1830	NY
1832	NY
1845	MA
Lagurus ovatus L.[c]	
1859	MA
1860	MA
1862	MA
1866	NY
1869	NY (2)
1870	NY (2)
1875	NY; PA
1876	NY
1877	NY
1880	MI
1883	IL; NY; PA
1885	DC; MA; NY (3)
1887	IN
1888	PA (2)
L. ovatus (Continued)	
1890	IA; MA NY (2); PA
1893	NJ
1894	PA
1894/95	CA
1895	NJ; NY
Pittosporum undulatum Vent.	
1826	PA
1828	PA
1844/45	PA
1845	OH
1862	MA
1869	MA (2); NY
1886	CA
1895	CA
1899	CA
Rhododendron ponticum L.[c]	
1811	PA
1824	PA
1826	NY; PA
1828	PA
1829	NY
1833	MA (2)
1841	NY
1844/45	NY (2); PA
1846/47	OH
1847	NY
1848	OH
1850/51	MA
1855	MA
1863	NY
1869	NY (2)

[a] Bailey (1949)
[b] Beadle *et al.* (1972)
[c] Clapham *et al.* (1987)
[d] Tutin *et al.* (1980)
[e] equals *Bryonia cretica* L. subsp. *dioica* (Jacq.) Tutin (Clapham *et al.* 1987)

Table 3. Weedy native species that may have undergone range extension by being sold in the 19th century. Superscripts refer to authorities for nomenclature; species without superscripts are according to Fernald (1950).

Catalog Date	Seedsman Location
Asclepias tuberosa L.	
1804	PA
1826	NY
1829	NY
1831	NY
1833	MA
1835	OH
1839	NY
1844/45	NY
1847	NY
1860	MA
1866	MA
1870	NY
1886	MA
Asclepias verticillata L.	
1831	NY
1833	MA
1839	NY
1886	MA
Azolla filiculoides Lam.	
1899	PA
Celastrus scandens L.	
1862	PA
1875	NY
1883	IL; NY
1884	CA
1886	NY
1890	MI; NY (2)
1895	MI
Cicuta maculata L.	
1804	PA
1825	NY
Datura stramonium L.	
1807	PA
1875	NY
Echinocystis lobata (Michx.) T. & G.	
1859	MA
1869	MA
1883	MA
1899	MA; NY; OH; OR (2)
Eschscholtzia californica Cham.	
1834/35	MA
1835	OH
1847	NY
1852	NY
1860	MA
1863	NY
1866	NY
1868	MI
1869	MA
1870	MA; OH
Eupatorium hyssopifolium L.	
1885	MA
Eupatorium maculatum L.	
1831	NY
1839	NY
Eupatorium perfoliatum L.	
1875	NY (2)
1885	NY
1888	MA
1890	NY
1899	MA; NY
Eupatorium purpureum L.	
1885	MA
Euphorbia corollata L.	
1807	PA
1859	RI
1880	NJ; NY
1885	MA
1886	MA
1888	MA (2)
1890	MA
1893	NJ
1895	NJ
1899	IL; MA; NC; NJ; NY (2)
Euphorbia heterophylla L.	
1899	MA
Galium boreale L.	
1875	NY
1885	MA
1888	MA
Mikania scandens (L.) Willd.	
1835	NY
1839	NY
1886	MA

Table 3 (Continued)

Catalog Date	Seedsman Location
Passiflora incarnata L.	
1807	PA
1828	PA
1845	NY
1885	MA; PA
1886	PA
1888	DC; KY; MO; PA
1889/90	NY
Phlox drummondii Hook.	
1855	MA
1871	MI
1874	MI
1875	NY
1880	MI
1884	NY
1888	LA
1890	LA; MA (2); MI; NY (2); PA (2)
1894	NY
1895	MI
Pistia stratiotes L.[a]	
1884/85	NJ
1886	PA
1888	PA
1889/90	NY
1890	FL; PA
1892	FL
1895	FL; NJ
1899	KY; MA; NY; PA
Pontederia cordata L.	
1804	PA
1807	PA
1867	MA
1870	NY
1884/85	NJ
1885	MA
1888	MA; PA
1889/90	NY
P. cordata (Continued)	
1890	FL; MA;
1899	PA; WI
Sapindus saponaria L.[a]	
1895	FL
Silphium perfoliatum L.	
1889/90	NY
Utricularia vulgaris L.	
1885	MA
1888	MA

[a] Correll & Johnston (1970)

some species native to North America likely increased (Table 3). Many of these species are either seemingly innocuous or rare, or both, in their new range. *Phlox drummondii* Hook., a native of eastern Texas, is now occasionally found on disturbed sites in the eastern U.S. (Fernald 1950). Others have become weeds of varying severity. *Echinocystis lobata,* native to the eastern U.S., was commonly sold for arbors and its unusual fruit. It is now naturalized in the western U.S. (Correll and Johnston 1970; Welch et al. 1987) and is locally a pest along stream courses. The current ranges of several native aquatic weeds (*Pistia stratiotes* L., *Pontederia cordata* L.) may also reflect dispersal in conjunction with their use as ornamentals. To what extent the putative native ranges of species in the U.S. are partially artifacts of the early trade in their seeds probably cannot be determined. Consequently, it is plausible that a species, especially a ruderal, could have reached a new site and have become well established before it was recognized as naturalized (Smith 1986).

Breeding Practices and Plant Features that Enhanced the Weediness of Alien Species

Both the practices of seedsmen and the characteristics of the alien species they were disseminating facilitated naturalizations in the 19th century. For instance, repeated transoceanic introductions of plants provide a partial explanation for the difficulty today in controlling some alien weeds (Burdon and Marshall 1981). Given the large native range from which seeds of some species could be gathered, each deliberate introduction probably increased the immigrant's genetic variation and facilitated the production of novel phenotypes in the new range (Barrett 1982). For example, the many multilocus genotypes in *Echium plantagineum* L. in Australia have arisen through the repeated deliberate and accidental introductions of this self-compatible outbreeder (Brown and Burdon 1983; Piggin 1977). The potential for new phenotypes is further increased if allopatric congeners hybridize, as when brought together in the same nursery. The aggressive shrub *Lantana camara* L. is a polyploid complex that apparently arose in this manner when its nonweedy progenitor species were repeatedly hybridized (Stirton 1977).

Other post-immigration events further influenced the gene pool of these species in their new

range. Even before 1800 the majority of seedsmen were selling material they had produced locally as opposed to serving only as middle men for European sources. Successive growouts year-after-year would have selected for those phenotypes (and eventually races) attuned to the local environment, thereby enhancing the opportunity for establishment if the species escaped from cultivation (Harper 1965).

Most woody species are sold today as potted seedlings or plants grown from cuttings, but in the 19th century most of these species along with herbs and grasses were mailed as seeds. Although such a practice would have operated against the establishment of species with complicated dormancy or a fragile seedling stage, dispersal as seeds offers distinct advantages to a potential invader. Viable seeds are an obviously reliable means for dispersal over great distances. Furthermore, the sale of seeds consciously selected for species that reliably display sexual reproduction, thereby providing a potential source of heterozygosity. The general lack of intensive breeding programs in the 19th century—including the production of sterile hybrids, controlled pollinations, and artificial selection for domestication—meant that these commercial populations were likely to have retained wild characters that enhanced their ability to escape cultivation. For instance, the selection of "double" (and, therefore, usually sterile) flowers was not widely practiced. (An early exception is *Bellis perennis* L.) Unlike accidentally spread seeds, seeds sold through these catalogs were usually sown at high density and cultivated (provided with water, etc.), thereby enhancing the opportunity for these founders to survive, mate, and produce naturalized descendants. The probability for extinction through demographic stochasticity (Lande 1988) for a founder population established in this manner would have been lower than for accidental immigrants.

Implications of Plant Introductions in the 19th Century

Information in these 19th century catalogs holds much value for investigating the epidemiology of many plant invasions. (1) Even general knowledge of the geographical distribution of these 19th century seedsmen and the chronology of their businesses is useful in understanding the character and speed of plant invasions. For instance, seed catalogs illustrate the ease with which deliberately introduced species could have spread. (2) In addition to other printed contemporary accounts, herbarium specimens, and fossil pollen spectra (e.g., Davis et al. 1977; Stuckey 1980), seed catalogs are an independent line of evidence as to the time by which an immigrant species had arrived in a new range. The earliest known date(s) of entry provide a time line from which subsequent events in the invasion can be scaled (Forcella and Harvey 1983; Mack 1981). In the case of several prominent alien weeds, such as *Eichhornia crassipes* and *Schinus terebinthifolius,* seed catalogs indicate their arrival earlier than had been previously believed. (3) These records establish a minimum number of points of introduction (and reintroduction) of the invader in the new range; in effect, each seedsmen's garden was a focus for potential spread. (4) Since most seedsmen raised these plants locally, these records provide circumstantial evidence as to the duration and character of selection that occurred in these immigrant populations. (5) Knowing which alien species were repeatedly introduced in the past and yet failed to become naturalized can lead to identifying the plant features that cause plants to fail in a new range.

Despite the prevalence of seed catalogs today, existence of a seed trade industry for over 2 centuries in this country (and much longer in Europe) has not been emphasized in tracing the growth of U.S. agriculture in general (Hedrick 1950; Lawrence 1969; Rehder 1936) or the growth of the alien plant flora in particular. Given the thoroughness with which agents of seed disperal were compiled earlier in this century and the wide recognition of weeds moving as contaminants in seed lots (Ridley 1930), it is surprising that such an important category of seed dispersal has largely escaped attention. (Common statements in local floras about a species having escaped from cultivation fail to convey any notion of the industry that now seems likely to have transported its progenitors to that site.) Furthermore, information from 19th century seed catalogs has rarely been incorporated into reconstructions of plant invasions (but see Horton 1964; Piggin 1977). Yet the ease with which seeds, etc. were transported into and throughout the U.S. from at least 1865 onward shows that almost any alien species could have been rapidly and repeatedly introduced into its new range.

Recognition of the pervasiveness of this agency of dispersal throughout the continent complicates any vision of plant invasions operating as simple wave-like or diffusion phenomena (Okubo 1980), except at a local level. With each seedsman serving as a focus for introduction and in turn establishing numerous new foci through his customers, it is little wonder that many alien species appeared from coast to coast within a few years. Consequently, the invasions of the species discussed here likely stemmed from the creation of many small, isolated foci, and this scenario should be considered in any model of the invasion of a deliberately introduced plant (Moody and Mack 1988). Future reconstructions of past invasions will need to consider this agency for dispersal much more than has previously been the case (Foy et al. 1983; Mack 1985, 1986).

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