Merremia discoidesperma: Its Taxonomy and Capacity of Its Seeds for Ocean Drifting

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Merremia discoidesperma *(Donn. Sm.) O'Donell (Mary's-bean) is a rarely collected and inadequately described high climbing woody liana of Chiapas, Mexico; Guatemala; Costa Rica; Hispaniola; and Cuba. There is only one record of this species being cultivated and this from Guanajuato, Mexico in 1894, though seeds are used in folk remedies. These seeds are topographically unlike other known convolvulaceous seeds, thus permitting their positive identification. Because seeds remain buoyant for more than three years in seawater, those produced in the Caribbean and Atlantic drainage region may be transported by the Gulf Stream System as far north as the Norwegian coast, a distance of about 9,500 km. Seeds produced in the Pacific drainage region from Chiapas, Mexico south to Costa Rica may be transported by the North Pacific Equatorial Current as far west as Wotho Atoll in the Marshall Islands, a distance of about 11,000 km. Records of drifting and subsequent stranding of these and other tropical New World disseminules are supported by drift bottle studies and drift debris records in the Atlantic Ocean. In the Pacific Ocean region distribution of stranded Mary's-bean seeds is supported by a similar distribution of New World pumice. There is an indication in the literature that Mary's-bean seeds may drift to the Philippines. The record from Wotho Atoll to Norway constitutes the widest drift range of any seed or fruit which has been documented. Other tropical disseminules may drift as far or farther, but their origins cannot be ascertained with certainty. The plant is described, its synonyms listed, and its distribution as well as the distribution of its stranded seeds recorded.*

INTRODUCTION

While preparing a book on common tropical drift seeds and fruits (Gunn and Dennis, 1976), it became apparent that seeds and plants of *Merremia discoidesperma* (Donn. Sm.) O'Donell (Mary's-bean) were poorly understood. Because of the design of this book, it was not possible to give a full account of this intriguing species. Additional evidence was uncovered to indicate that these seeds are the most widely ranging drift seeds which have been documented. Lianas which produce these drift seeds are endemic to Chiapas, Mexico; Guatemala; Costa Rica; Hispaniola; and Cuba. Citations of this species in Nicaragua (Williams, 1970 and 1973) and Panama (Seeman, 1854) are based on seed collections, not on plant collections. At least for the present, these two countries should be dropped from the plant distribution record. Austin (1975) did not include this species in the flora of Panama. While the distribution of this species may not be fully known and its description inadequate, its seeds have been illustrated in drift literature for nearly 400 years.

In addition to the common name Mary's-bean, this species is also known as *quiebracajete* in Guatemala (Steyermark's sheet numbered 49138), *almorrana* or *tomate de mar* (Leon and Alain, 1957), and *ppak i kaknab* which means *tomate del mar* by the Mayans of the Yucatan (Andrews, private communication).

John Donnell Smith (1889), the father of Central American botany, was the first botanist to give the Mary's-bean a post-Linnaean binomial, *Ipomoea discoidesperma,* the morning glory with discoid-shaped seeds. While he described the plant, capsule, and seed, they were not illustrated, and there was no reference to the drift seed literature. Smith referred to capsules and seeds in the Herbarium of the Royal Botanic Gardens, Kew which were described but not illustrated by Seeman (1854). Seeman did not refer to the drift seed literature and noted that the capsules and seeds he studied were sent by Don Juan Ansoatigni, Veraguas, Panama. It is obvious from the presence of fragile capsules and from pubescence on seeds that they did not drift to Panama.

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Three years after Smith's paper, Hemsley (1892) popularized a myth that has been perpetuated by other authors. Hemsley did not mention Lindman and Oliver (discussed in the North Atlantic region section) when he amended the original description of *Ipomoea tuberosa* L. (now *Merremia tuberosa* (L.) Rendle), wood-rose, to include drift Mary's-bean seeds. His myth is summarized in a plate which has been rearranged for clarity and reproduced as Figure 1. Hemsley clearly understood what the "normal" seeds and capsules of *M. tuberosa* looked like, because they are accurately illustrated (Fig. 1, A–D, H). Even the tendency of wood-rose seeds to fall as 2- to 4-seeded units is accurately portrayed. Naturally occurring 1-, 2-, and 4-seeded units of wood-rose removed from a 50-year-old Leonard sheet (8765, Ennery, Haiti) were photographed next to a Mary's-bean seed from an Abbott sheet (2404, Samaná, Dominican Republic) (Fig. 2, P–S). Hemsley incorrectly postulated that it was a simple evolutionary step from the quartet of wood-rose seeds to the single seed of the Mary's-bean. It is obvious from its large size, the size and position of the hilum, and the cross impressed on its ventral side that a Mary's-bean seed occupies the place of four ovules in its fruit. However, it is not accurate to state that a Mary's-bean seed is an "abnormal" drift seed of the wood-rose. Hemsley was apparently unaware that "normal" wood-rose seeds drift. He also failed to consider that drift Mary's-bean seeds had only been found in the North Atlantic at the time he wrote his paper. Yet he recognized the wood-rose as a pantropic species. Apparently Hemsley never saw a Mary's-bean capsule though Seeman referred to a capsule. If Hemsley had, he would have quickly recognized that a Mary's-bean capsule did not bear an indurate calyx (Fig. 7, E) and that its capsule was more fragile than a wood-rose capsule. Finally, as Smith discovered three years earlier, a Mary's-bean plant is dissimilar in many respects from a wood-rose plant.

Gunn (1968) was the first author to publish the correct specific name for a drift Mary's-bean seed, though he followed Smith in placing the species in *Ipomoea*. The first correct scientific name published for a drift Mary's-bean seed was in Gunn and Dennis (1972) and in subsequent papers by these authors. This was 367 years after the first illustration and description of this drift seed was published by Clusius (1605).

A BUOYANT SEED

Most tropical seeds and fruits (disseminules) do not float in seawater, because their specific gravity is greater than the specific gravity of seawater. In order for the few species (estimated to be less than 10%) whose disseminules do float to qualify as drift disseminules, they must be able to float in seawater for at least one month. There are five primary buoyancy principles, viz, buoyancy due to a cavity within the disseminule, buoyancy due to lightweight cotyledonary tissue, buoyancy due to a fibrous and/or corky layer, buoyancy due to thinness of the disseminule, and buoyancy due to a combination of the listed characters. Mary's-bean seed buoyancy is caused by a cavity within the center of the convoluted and contorted embryo (Figs. 1, G and 2, I). Viability is not a criterion, because some drift seeds never contain an embryo, some lose their viability during drifting, while others are stranded in a viable condition. If drifting is to contribute to the spread of the species, environmental factors must be such that seedlings will be permitted to mature and reproduce.

Mary's-bean is one of a few species of tropical disseminules which is able to float for more than three years in seawater (Table 1). These and other disseminules were floated in jugs filled with seawater. The disseminules were washed in fresh water each week to remove accumulated slime, drained, and seawater replaced. Most tested disseminules came from New World or cosmopolitan species, because Pacific region disseminules were not available in sufficient quantity. A complete list of tested disseminules and their buoyancy duration may be found in Gunn and Dennis (1976).

The Mary's-bean seed is unique in the Convolvulaceae because of its large size, its conspicuous seallike hilum, and an impressed cross on its dorsal side (Fig. 2, A–I, S). Reasons for these characters are discussed in the taxonomic section. While this seed is topographically dissimilar from known members of the family, its ability to drift is

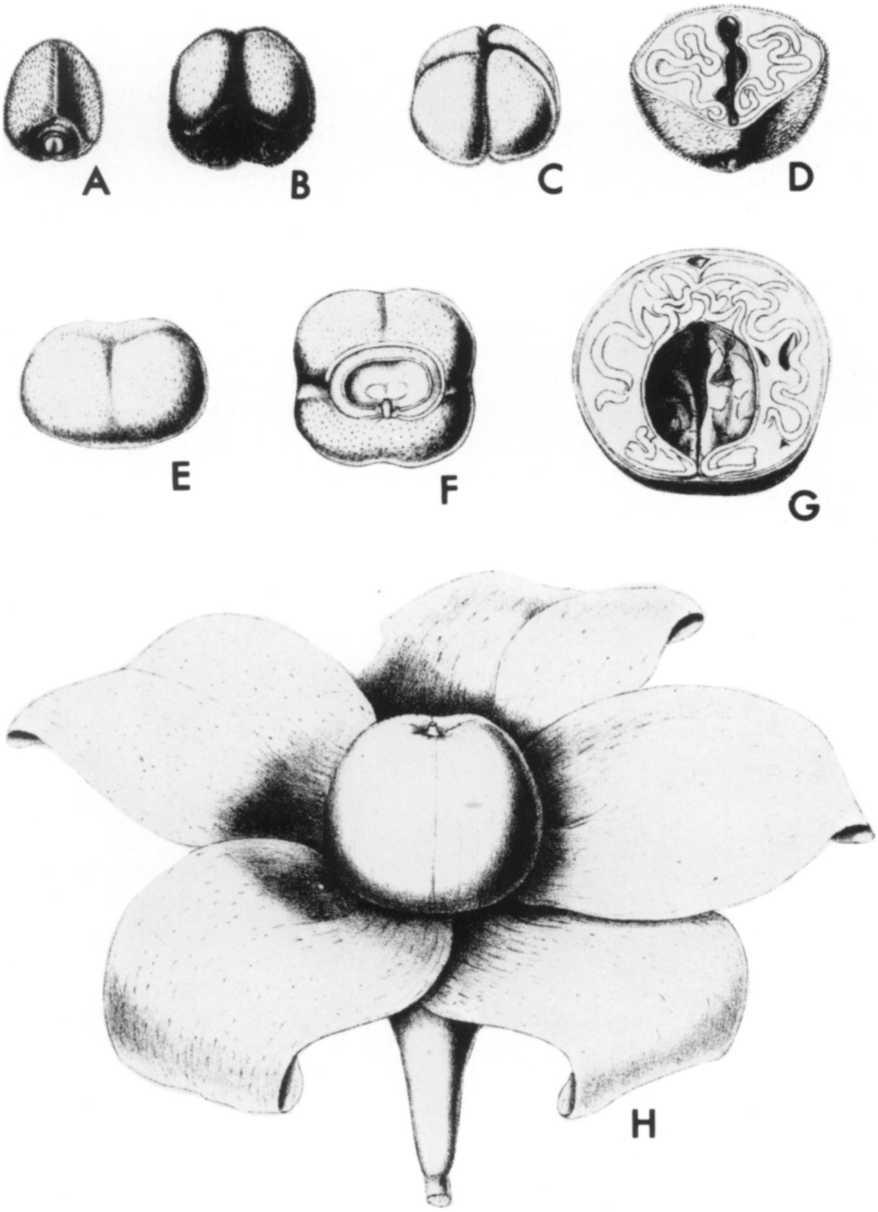

Fig. 1. A slightly rearranged reproduction of a plate in Hemsley (1892). A–D, H, seeds and fruit of *Merremia tuberosa* (L.) Rendle and E–G, seeds of *M. discoidesperma* (Donn. Sm.) O'Donell. (Cross and longitudinal sections × 2, remainder × 1.)

shared by other convolvulaceous species, including *Ipomoea alba* L., *Ipomoea macrantha* R. & S., *Ipomoea pes-caprae* (L.) R. Br., several unidentified *Ipomoea* spp., and *M. tuberosa* (L.) Rendle (Figs. 1, A–D and 2, J–R).

The significance of finding a stranded Mary's-bean seed involves both its unique seed features and the limited distribution and number of individual plants. There is only one record of this species being cultivated. Duges collected the liana in the garden of the

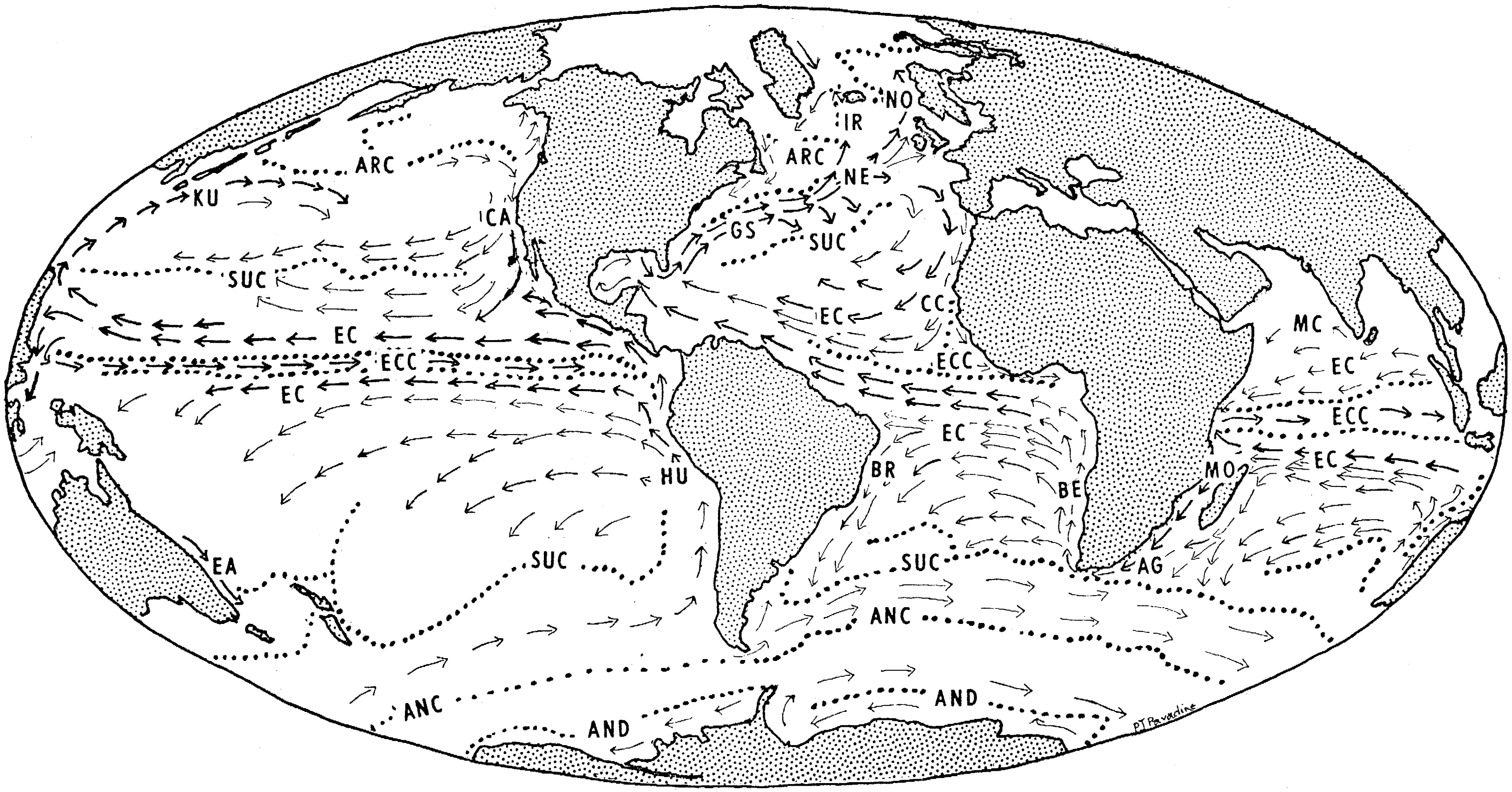

Fig. 3. Darker arrows show directions of currents with a velocity of more than 36 nautical miles per day, while lighter arrows show direction of currents with a velocity of 36 or less nautical miles per day. Dots represent current boundaries. Arrow and dot locations are approximations. Dots: ANC = Antarctic Convergence; AND = Antarctic Divergence; ARC = Arctic Convergence; SUC = Subtropical Convergence. Arrows: AG = Agulhas Current; BE = Benguela Current; BR = Brazil Current; CA = California Current; CC = Canary Current; EA = East Australia Current; EC = Equatorial Current; ECC = Equatorial Counter Current; GS = Gulf Stream; HU = Humboldt Current; IR = Irminger Current; KU = Kurishio Current; MC = Monsoon Current; MO = Mozambique Current; NE = Northeast Atlantic Current; NO = Norwegian Current.

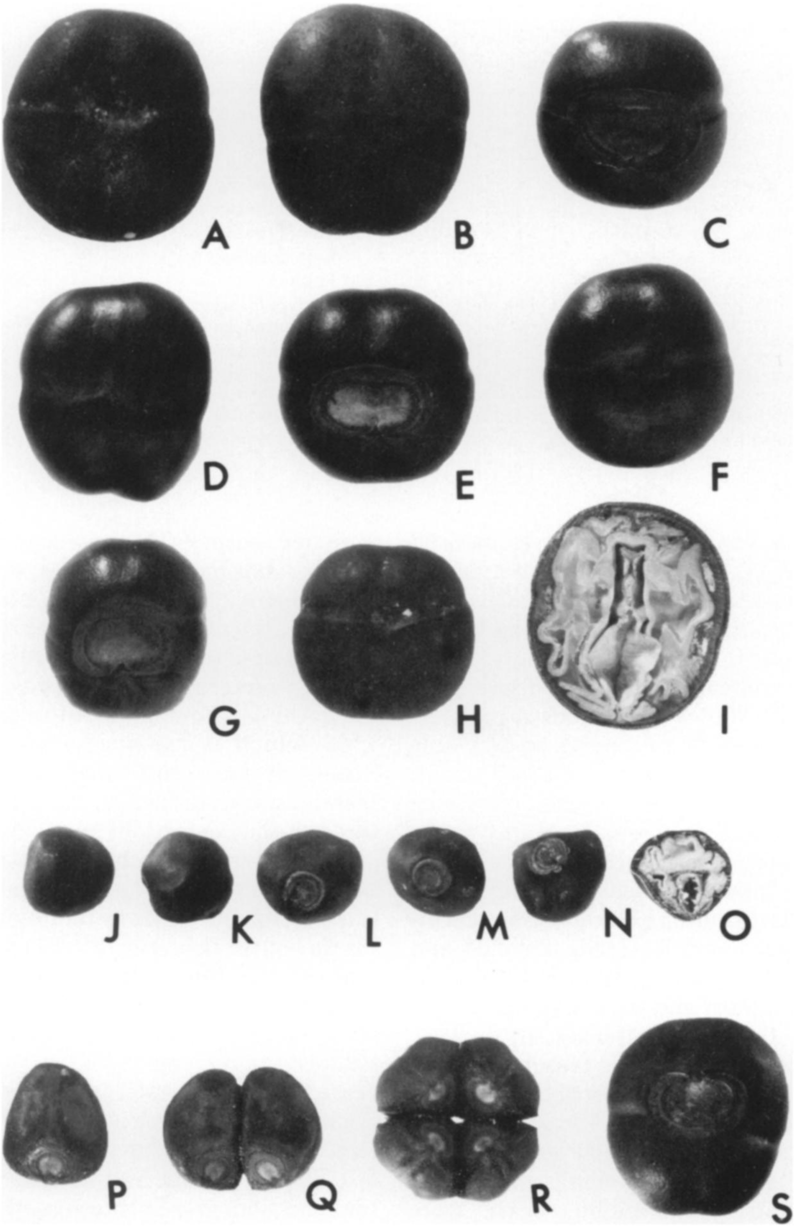

Fig. 2. Seeds of *Merremia discoidesperma* (A–I, S) and *M. tuberosa* (J–R). Seeds A–O are drift seeds, P–S are from herbarium specimens identified in the text. A, B, D, F, H, J, K dorsal views; C, E, G, L–N, P–S hilar views; I, O longitudinal section; Q, R naturally occurring 2- and 4-seeded clusters (× 1).

University of Guanajuato, Mexico in 1894. Because their sources are known, the distribution of Mary's-bean seeds by ocean currents may be accurately traced. Seeds produced by lianas growing along the coast or drainage area of the Caribbean Sea and Atlantic Ocean may reach Norway, a distance of some 9,500 km via the Gulf Stream System (Fig. 3). Lianas growing in Chiapas, Mexico; Guatemala; and Costa Rica may produce seeds which reach Wotho Atoll in the Marshall Islands, a distance of some

Table 1. Tropical drift seeds and fruits which floated for more than three years in seawater filled jugs.

Scientific Name	Family	Present Plant Distribution[1]
Barringtonia asiatica (L.) Kurz	Barringtoniaceae	Cosmopolitan
Caesalpinia bonduc (L.) Roxb.	Leguminosae	Cosmopolitan
Cocos nucifera L.	Palmae	Cosmopolitan
Dioclea reflexa Hooker f.	Leguminosae	Cosmopolitan
Entada gigas (L.) F. & R.[2]	Leguminosae	New World
Entada phaseoloides (L.) Merrill[2]	Leguminosae	Pacific
Hymenaea courbaril L.	Leguminosae	New World
Manicaria saccifera Gaertner	Palmae	New World
Merremia discoidesperma (Donn. Sm.) O'Donell	Convolvulaceae	New World
Mucuna sloanei F. & R.	Leguminosae	New World
Mucuna urens (L.) Medicus	Leguminosae	Cosmopolitan
Sacoglottis amazonica Martius	Humiriaceae	New World

[1] Fresh disseminules of Pacific region endemics were usually not available.

[2] In drift literature these two species were referred to as *Entada scandens* Bentham whose distribution was cosmopolitan.

11,000 km, via the North Pacific Equatorial Current (Fig. 3). The possibility that one or more Mary's-bean seeds have reached the Philippine Islands is discussed in the Pacific region section.

Little is known about drift disseminule viability, and Mary's-bean seeds are no exception. These seeds are known to be viable when they strand on beaches of southeastern Florida. There are no records of viable stranded seeds being found on any other beach. Viability of the Florida stranded seeds was determined chemically using 2, 3, 5-triphenyl tetrazolium chloride or by scarification and germination. Seeds scarified and planted in a backyard at West Palm Beach, Florida germinated and the young plants survived until they were attacked by insects. Perhaps insect attack is one reason why this species has such a limited distribution. Other seeds scarified and planted in potting soil were sources of germination and seedling data described in the taxonomic section. In order to initiate imbibition, seeds were scarified with a triangular file until the white interior was visible. After soaking seeds in tap water for 24 hours, they were planted vertically with their hilar notch down.

It is reasonable to assume that viable seeds have also reached beaches of countries south of Florida. While it appears unlikely that most of these seeds were able to produce adult plants) the vines found on Hispaniola and Cuba may have arisen from viable stranded seeds. This would explain why these islands have this species, but it does not explain why other Caribbean islands and the eastern coast of Mexico do not have this liana. The citation of *M. discoidesperma* on Isla Verda, Veracruz, Mexico (Vasquez-Yanes, 1971; Gomez-Pompa, 1973) is based on Lot 1360 which is *Ipomoea stolonifera* Poir. Sheets of Lot 1360 labelled *M. discoidesperma* were studied at the Field Museum through the courtesy of Larry Nevling.

While there is no solid evidence that viable Mary's-bean seeds reach European beaches, it is possible for seeds to retain their viability for the one to two years it takes to drift there. One of the Mary's-bean seeds which had floated in the buoyancy test for more than three years was scarified, imbibed, and developed an emergent radicle. The radicle ceased elongating after it reached a length of 3 mm. Seeds of two legume species of similar size, shape, seed coat thickness, and weight also drift to Europe and some arrive in a viable condition, viz, *Entada gigas* (Hobbs, 1969; Lloyd-Jones, 1893) and *Mucuna* cf. *sloanei* (Clough, 1969). Because of a similar distance and travel time in the Pacific Ocean, it is possible that some seeds drifting to the environs of the Marshall Islands may be viable.

Mary's-bean Seeds Stranded in the North Atlantic Region

Stranded Mary's-bean seeds have been collected from beaches of Nicaragua (US);

Yucatan Peninsula (Andrews, CZ-81, CZ-134, TA-30, TA-110, TA-131); Jamaica (K); Hispaniola (US); Turks Island (K); Cuba (Guppy, 1917, though open to some doubt); Padre Island, Texas and Holly Beach and Cameron, Louisiana (Gunn and Dennis, 1973); southeastern Florida (Gunn, 1968); Ireland (National Museum of Ireland); Hebrides (K and Pennant, 1809); Orkney Islands (Wallace, 1693 and 1700); Shetland Islands (Guppy, 1917); and Norway (Lindman, 1882). No Mary's-bean seeds have been collected from two eastern United States shorelines which have been searched, viz, Carolina (Gunn and Dennis, 1972) and the environs of Cape Cod, Massachusetts (Dennis and Gunn, 1974).

North of the Straits of Florida (between the Florida Keys and Cuba), Mary's-bean seeds are transported by the Gulf Stream System (Fig. 3). Its regular transport and predictable stranding of tropical drift disseminules was cited by Gumprecht (1854) as evidence that the Gulf Stream System was the major North Atlantic current uniting the New World with Europe. Major drift bottle experiments conducted by Prince Albert I of Monaco and others have been summarized by Carruthers (1956). These experiments coupled with the transportation of tropical animals and plants (other than disseminules); U.S. buoys like the Port Royal Sound, South Carolina buoy; and identifiable parts of wrecked ships clearly demonstrate the impact of the Gulf Stream System as a major transport current.

Like other long distance drift disseminules, drift Mary's-bean seeds were known hundreds of years before the plant was discovered and named. The first published record of tropical drift disseminules reaching European beaches was too general to permit identification of the species involved (Pena and L'Obel, 1570). However the drawing and description published by Clusius (1605) is unquestionably a Mary's-bean seed (Fig. 4, A). Clusius described this seed among other disseminules from Jacobus Garetus and labelled them as "stranded seeds" without knowing what kind of plant produced them and where the plant grew. The history of another illustrated drift disseminule published by Clusius, *Sacoglottis amazonica* Martius, has been reviewed by Morris (1895, 1899) and Cuatrecasas (1961). Bauhin (1623) cited and Bauhin and Cheler (1650) cited and reproduced Clusius' original description and illustration of a Mary's-bean seed and included two original drawings (Fig. 4, B, C). Jonston (1662) cited both Clusius and Bauhin and Cheler and included two original illustrations (Fig. 4, D, E). Another original illustration of a drift Mary's-bean seed was published by Wallace (1693) and reproduced in Wallace (1700). While this drawing (Fig. 4, F) is diagrammatical, it clearly depicts the dorsal side of a seed. Drift seeds which were collected from the Orkney Islands, the area which Wallace wrote about, were given the collective common name Molucca-beans. The collective scientific name was *Phaseoli moluccani*. Both names were used by the English speaking people during this period.

Sloane (1698) correctly associated disseminules of Jamaican plants with tropical drift disseminules stranded on Orkney beaches and suggested that transportation was via currents and prevailing winds in his remarkable paper, AN ACCOUNT OF FOUR SORTS OF STRANGE BEANS, FREQUENTLY CAST ON SHOAR ON THE ORKNEY ISLES, WITH SOME CONJECTURE ABOUT THE WAY OF THEIR BEING BROUGHT THITHER FROM JAMAICA, WHERE THREE SORTS OF THEM GROW. Using his firsthand knowledge of the Jamaican flora (Sloane, 1696), the available literature, and freshly collected seeds of four species sent to him by George Garden, Aberdeen, Sloane identified three of the four species by their pre-Linnaean names which he used in his flora. We now know them as *Caesalpinia bonduc* (L.) Roxb., *E. gigas* (L.) F. & R., and *Mucuna* sp. (*Mucuna sloanei* F. & R. or *Mucuna urens* (L.) Medicus). He could not identify the fourth species, because it was a Mary's-bean seed and the plant was unknown to him, though he felt certain that it was a West Indian species. He referred to several Mary's-bean seeds in a "collection of rare fruits" and cited the available literature. Apparently Sloane had other Mary's-beans in his possession, but he did not discuss them. Petiver (1702) illustrated a Mary's-bean seed

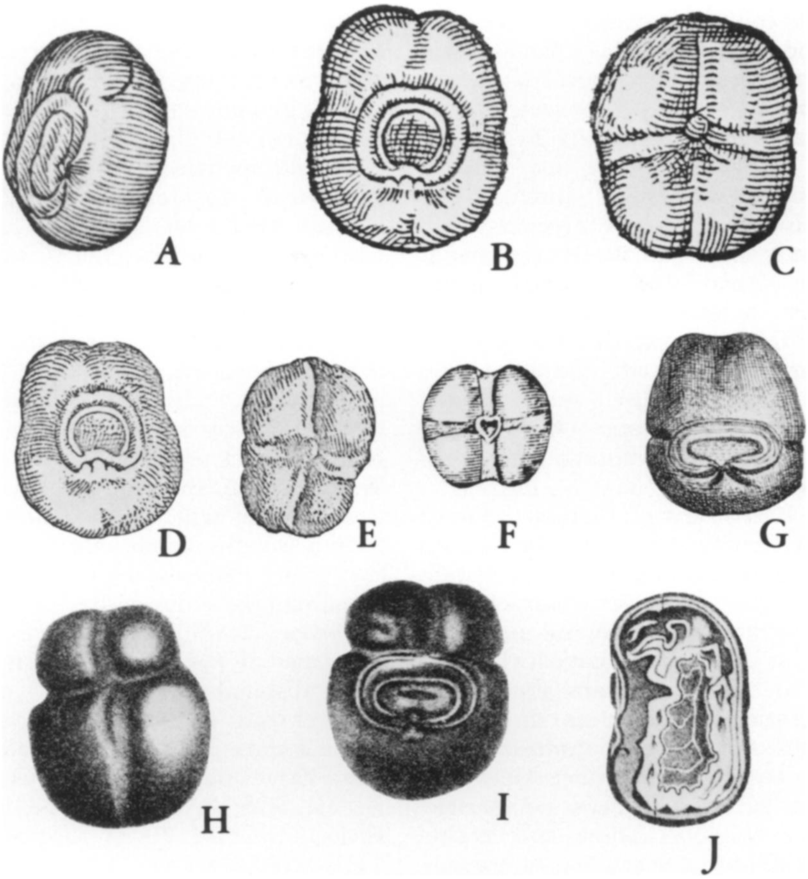

Fig. 4. Historical illustrations of stranded Mary's-bean seeds from beaches bordering the North Atlantic Ocean. A from Clusius (1605); B, C from Bauhin (1623); D, E from Jonston (1662); F, Wallace (1693) and Wallace (1700); G from Petiver (1702); and H–J from Lindman (1882). All × 1.

(Fig. 4, G) and described it under the name *Faba orcadensis*. He cited the available literature and recorded a remarkable observation which is discussed in the next section. Pennant (1809) used the Bauhin name for a Mary's-bean seed. It was one of five different species of stranded disseminules which he described from the Hebrides. Lindman (1882) described ten tropical drift disseminules stranded on the east coast of Norway and illustrated two of them, *Dioclea reflexa* Hooker f. under the tentative name *Mucuna macroceratides* DC. and a Mary's-bean under the tentative name Convolvulaceae sp. The latter illustrations are among the finest printed (Fig. 4, H–J). Professor D. Oliver (Kew), who received a seed from Lindman, suggested that it was an *Ipomoea,* possibly *I. tuberosa*. Hemsley, as previously noted, either used this information without citing it or came to a similar and independent conclusion. While Lindman agreed with Oliver that the unknown looked like an *Ipomoea,* he believed there to be too many differences for it to be *I. tuberosa*. Baron H. Eggers of St. Croix also received a seed, and he noted that it was unknown in the West Indies. Lindman mused that stranded seeds of this species have been found on Florida and European beaches, yet no one knew the parent plants or their locations. Lindman's description of the external topographic features of the seed was carefully prepared though quaint. The dorsal side was described as "swollen like an eiderdown quilt." His description and analysis of the internal features, especially the cotyledons and endosperm, furnished the evidence for classifying the seed as convolvulaceous, possibly *Ipomoea*. He noted that freshly cut seeds had an aroma like the cut pods of *Ceratonia*.

European lore concerning drift Mary's-bean seeds is based mainly on the fact that this is a naturally occurring object which bears a cross. Christians give special significance to these seeds and gave them the common name, Mary's-bean for the Blessed Mother. In addition most of those who found these seeds lived by the sea and any object surviving the sea and cast ashore intact would have special meaning. One of the most interesting legends is one from the Hebrides. A woman in labor was assured an easy delivery, if at the proper time she clenched a Mary's-bean in her hand. Seeds were handed down from mother to daughter as treasured keepsakes. Unbeknown to Europeans, these seeds have also been used as cures in Mexico and Central America. Williams (1973) discussed the use of these seeds as an antidote for snake bite in Nicaragua. Andrews (private communication) was told by Don Pablo Bush that in the Veracruz area of Mexico Mary's-bean seeds are used as a cure for hemorrhoids. To be cured, one must carry a male and female seed in a back pocket. To sex the seeds, they are placed in fresh water to determine whether they sink or float. A floating seed and a sunken seed are chosen though it is not clear whether it is a male or female that floats. Don Pablo was cured by using these seeds.

Mary's-bean Seeds Stranded in the North Pacific Region

Prior to this paper there was no evidence that a New World drift disseminule moved westward in the Pacific Ocean. Except for records from islands immediately adjacent to the New World coast, there are only two bonafide records and both involve Mary's-bean seeds. Johnston (1949) discussed the distribution of *Rhizophora samoensis* (Hochr.) Salvoza. This New World species is also found in Polynesia, and he thought that the seedlings had drifted from the New World. He offered no evidence, other than its distribution, to support his hypothesis. The claims of Ridley (1930) that certain New World species produced disseminules which drifted westward are without merit, because the species he listed have a pantropic distribution.

The documented occurrences of stranded Mary's-bean seeds along the Pacific side of the New World and in Oceania are widely separated, viz, Puntarenas, Costa Rica (F); Clipperton Island (Sachet, 1962); and Wotho Atoll, Marshall Islands (US). The viability of these seeds was not determined. There is an undocumented account of a Mary's-bean seed from the Philippines in the literature.

Two stranded Mary's-bean seeds have been found on the Pacific coast of Costa Rica. Jonathan Sauer found one on the black sand beach near Boca Barranca, and Corinne E. Edwards found one on a beach at Puntarenas. Because the species is known from Costa Rica, it is likely that these seeds have a local origin.

Johnston (1949), in a thorough analysis of the flora and drift disseminules of San Jose Island in the Gulf of Panama, found neither stranded Mary's-bean seeds nor lianas. None of the other stranded disseminule surveys in Oceania listed seeds of *M. discoidesperma* (Carlquist, 1970; Clocker collection, Viti Levu, Fiji; Degener and Degener, 1974, Canton Island; Docters van Leeuwen, 1929; Fairchild, 1930; Guppy, 1906 and 1917; Hemsley, 1885; Kamerling, 1911; Kotzebue, 1821; Mason, 1961; Sachet, 1962; Safford, 1905; Schimper, 1891; Treub, 1888; van Zwaluwenburg, 1942; and Vincent, 1957).

Sachet (1962), in listing the stranded disseminules which she collected on Clipperton Island, was the only one to list a seed of *M. tuberosa*. Clipperton Island is located at 10.17 North and 109.13 West, about 2,500 km due west of Costa Rica. The nearest mainland, about 700 km to the north northwest, lies between Manzanillo and Acapulco, Mexico. Her description of the *M. tuberosa* seed clearly showed that she had collected a Mary's-bean. Unfortunately the seed cannot be located. Her description was supplemented by a note that the identification was based on Guppy (1917) and a Leonard and Leonard 12680 herbarium sheet from Haiti which bore a seed similar to her seed and labelled *I. tuberosa*. This sheet has now been

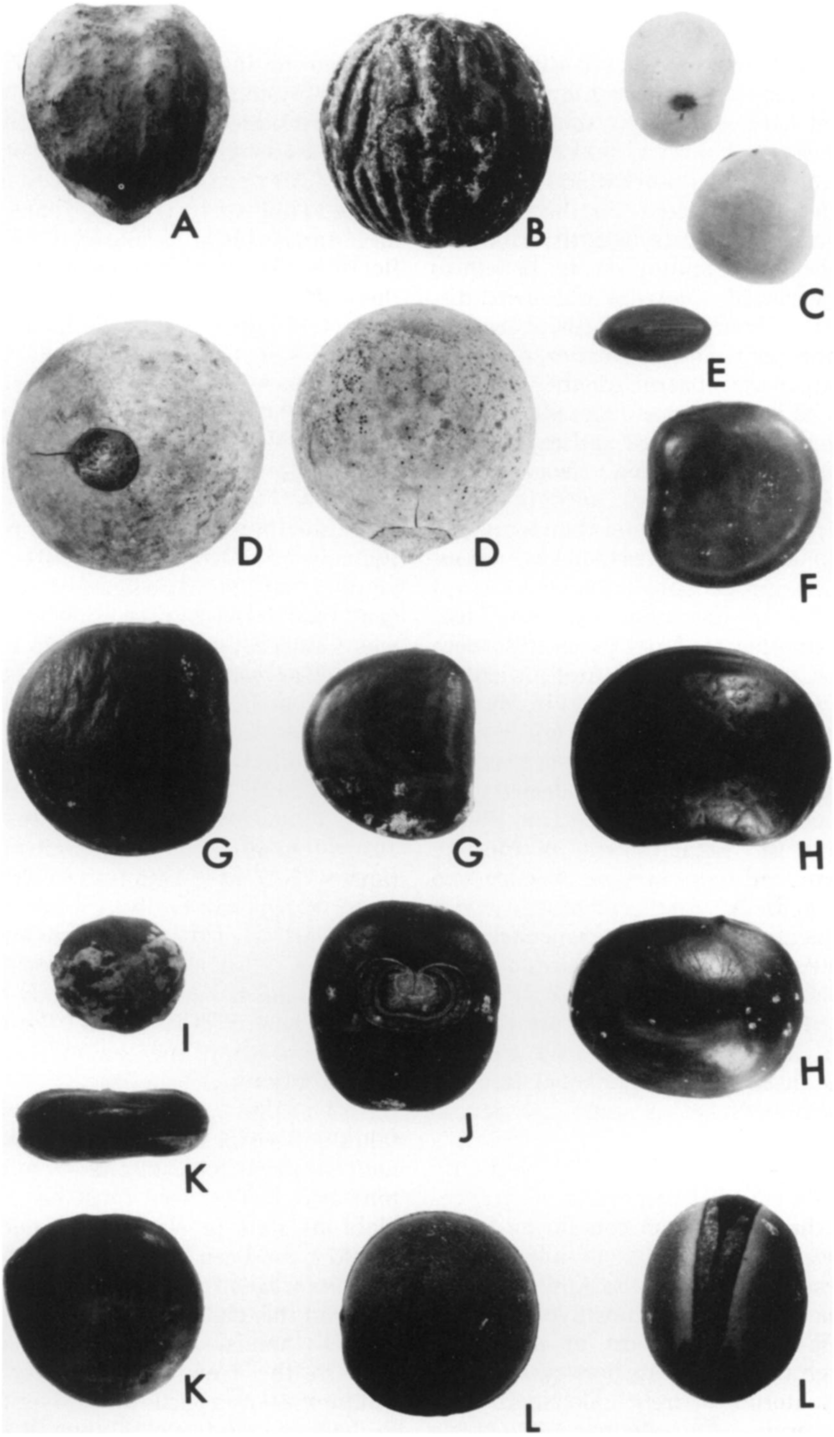

Fig. 5. Selected stranded disseminules from sample bag labelled "F. Raymond Fosberg 128, March 22, 1952, Medjaron, Mohemoh, and sandspit, northeast reef, Wotho Atoll, Marshall Islands." A, ***Aleuritès molluccana*** (L.) Willd.; B, ***Aleurites*** sp.?; C, ***Caesalpinia bonduc*** (L.) Roxb. (2 seeds); D, ***Calophyllum inophyllum*** L.; E, ***Canavalia*** sp.; F, ***Dioclea*** sp.; G, ***Dioclea reflexa*** Hooker f.; H, ***Dioclea*** sp.; I, ***Hernandia nymphiifolia*** (Presl) Kubitzki; J, ***Merremia discoidesperma*** (Donn. Sm.) O'Donell; K, ***Mucuna gigantea*** (Willd.) DC.; L, ***Mucuna urens*** (L.) Medicus; not shown, ***Mucuna*** sp. All × 1.

annotated with the correct scientific name, *M. discoidesperma*. Because she was led to believe that her seed was an abnormal drift seed of a pantropic species, her seed aroused no more interest than other ubiquitous drift disseminules she collected. She had become another victim of Hemsley's myth. Unknowingly, Sachet was only the second person to collect a verifiable New World drift disseminule in Oceania. Her discovery remained unrecognized for a dozen years. When I discovered its true identity and significance, its impact was eclipsed a month later during my study of her colleague's collection of drift disseminules from Wotho Atoll.

During a study of drift disseminules collected by F. Raymond Fosberg on various atolls in the Marshall Islands and on Guam, I found a Mary's-bean seed. This seed had been in a tied sample bag marked "Fosberg 128, March 22, 1952, Wotho Atoll, Marshall Islands" for 22 years. Wotho Atoll is located at 10.06 North and 165.59 East and lies between Bikini and Kwajalein at the northern end of the Ralik Chain. Selected disseminules from this bag are shown in Figure 5. All of the disseminules, except the Mary's-bean, are what one would expect to find on a Pacific Atoll beach that was near a major tropical current. To become stranded on Wotho Atoll, the Mary's-bean drifted for at least 11,000 km from its place of origin in southern Mexico or northern Central America in the North Equatorial Current (Fig. 3). It is unacceptable to believe that someone dropped the seed on the beach so that it could be beachcombed, or that this one seed could have been inadvertently dropped into the tied bag while in storage. This was the only bag to contain an unexpected disseminule.

The presence of the Wotho Atoll stranded Mary's-bean seed is not positive proof of transpacific ocean transport of this seed, even though there is a transport current, the North Equatorial Current. Collateral evidence concerning the effectiveness of this transport current is available in a well-documented account of New World pumice which drifted to the Marshall Islands. This pumice study may be used in lieu of drift bottle studies and drift debris observations referred to in the discussion of the Gulf Stream System. Richards (1958) traced the pumice produced from an eruption of Volcan Barcena on Isla San Benedicto off the west coast of Mexico from its source to Islas Revillagigedo and on to Hawaii, Johnson, Wake, and Marshall Islands. Based on collections of floating and stranded pumice, he determined these drift rates: to Hawaii 22 cm/sec (264 days, 4,800 km); to Johnson Island 33 cm/sec (225 days, 6,100 km); to Wake Island and Ailinginae Atoll (Marshall Islands) 18 cm/sec (about 560 days, 8,700 km). Ailinginae Atoll, in the Ralik Chain, is about 350 km southeast of Wotho Atoll. These rates should also apply to drift disseminules which drift at the ocean surface like this type of pumice. As Richards pointed out, the San Benedicto pumice "has little freeboard and the emergent part is streamlined." Therefore, drift was induced by ocean currents rather than wind. Mary's-bean seeds have the capacity to drift for at least three years, thus they are well within the time frame. In addition to the actual collections, Richards computed the current drift from surface current charts (U.S. Navy Hydographic Office, 1947 and 1950). These calculations confirm "that the range of current direction and velocity shown on the charts can easily account for the rate and direction of the actual pumice drift."

Petiver (1702) clearly knew the drift Mary's-bean seed, though not by this name, because he cited Clusius (1605) and Wallace (1700) and supplemented his text with an original drawing of the seed (Fig. 4, G). With these facts in mind the following observation takes on special significance: "Father Kamel hath also sent me the same from the Philippine Isles." This seed must have been in a glabrous state or else the presence of hairs would have been noted. It is not surprising that the fragile fruit was not mentioned. But how did this glabrous seed come into Father Kamel's hands? Did the Father obtain the seed in the New World, carry it to the Philippines, and then turn it over to Petiver? Perhaps some traveler gave it to Father Kamel? There is no way that these and other questions can be resolved at this late date, except to note that Petiver found nothing unusual about discussing a stranded seed from a European beach and then referring to the

Fig. 6. A flowering herbarium specimen of *Merremia discoidesperma* (Donn. Sm.) O'Donell.

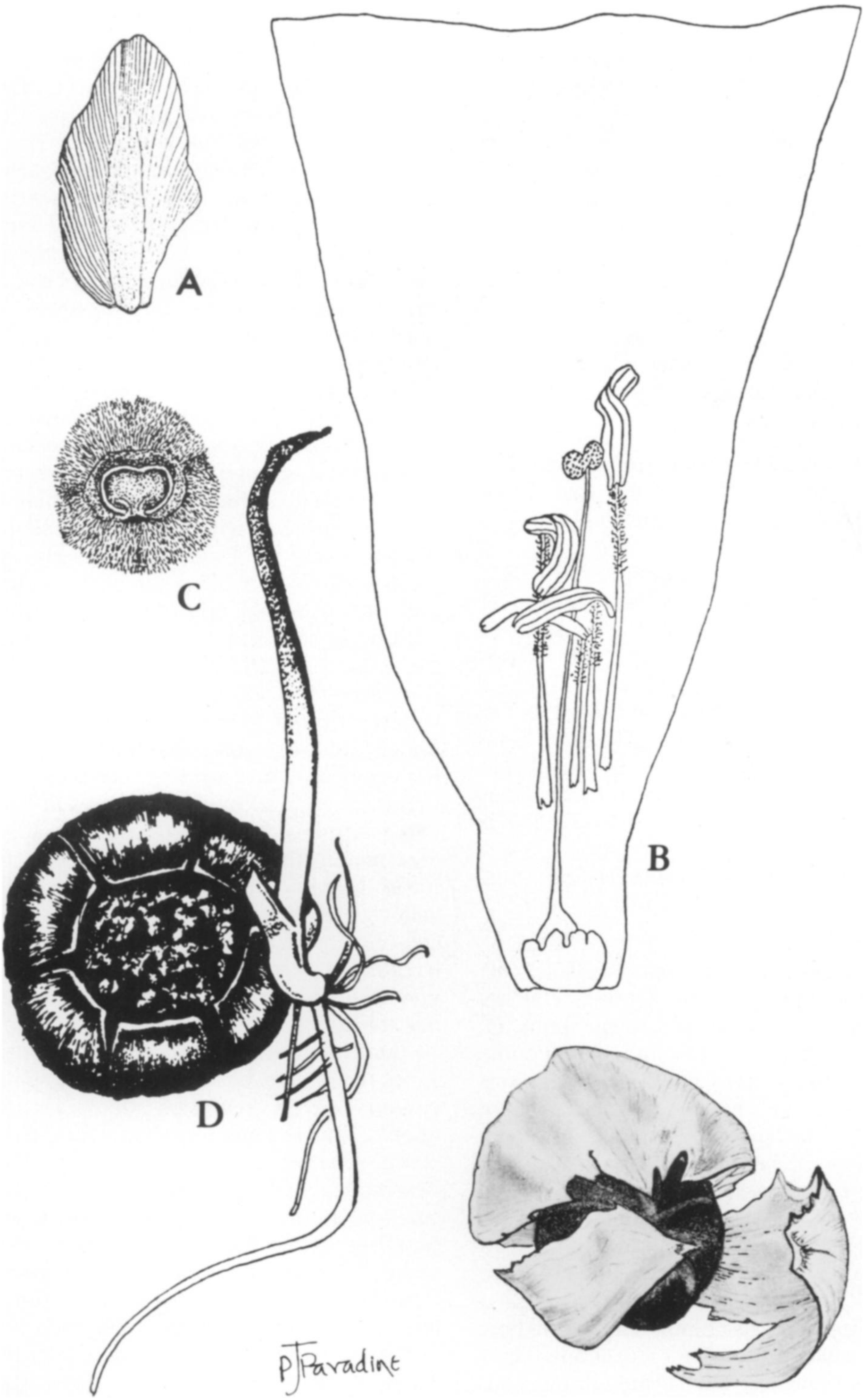

Fig. 7. Diagnostic features of *Merremia discoidesperma* (Donn. Sm.) O'Donell. A, outermost sepal (× 1.5); B, dissected flower showing biglobose stigma, position of stamens, twisted anthers, crinkled filament hairs, and cuplike lobed nectary (× 2); C, fresh pubsecent seed (× 1); D, germinating seed (× 1.5); and E, mature capsule rupturing irregularly to reveal solitary seed (× 1).

same seed sent to him by a Philippine correspondent. When one studies the current map it is relatively easy to trace a strong current from Central America and southern Mexico to the Philippines. This is the North Equatorial Current, which transported Mary's-bean seeds to Clipperton Island and Wotho Atoll and the San Benedicto pumice to Ailinginae Atoll.

TAXONOMY

MERREMIA DISCOIDESPERMA (Donn. Sm.) O'Donell, Lilloa 6: 495. 1941. (Figs. 6 and 7).

Ipomoea discoidesperma Donn. Sm., Bot. Gaz. 14: 27-28. 1889. HOLOTYPE: Tuerckheim 747, Pansamala, Guatemala (US!).

Operculina populifolia Hallier f., Bot. Jahrb. 16: 550. 1893; and Mededeel. Rijks. Herb. (Leiden) 1910: 22. 1911. ISOTYPES: Wright 3083 (pro parte), Bayamon, Cuba (GH! and MO!). A mixed collection with right plant on GH sheet and left plant on MO sheet being *Operculina triqueter* (Vahl) Macbride. Left plant on GH sheet and right plant on MO sheet are labelled by Hallier as *O. populifolia*.

Operculina discoidesperma (Donn. Sm.) House, Muhl. 5: 68. 1909.

Lianas high climbing (at least 20 m), woody, twining, glabrous. Upper stems hollow up to 1 cm in diameter, lower stems hollow and several cm in diameter. Petioles 5–11 cm long. Leaves glabrous, coriaceous, entire, 10–15 cm long, 5–12 cm broad, oval, rounded to cordate at base, acute to acuminate at apex, bearing (4–)5–7 pairs of lateral nerves, deep green above, paler below. Peduncles 3–8 cm long. Pedicels 2–10 cm long and thickened at apex especially in fruit. Bracts paired, not exceeding 3 mm in length, about 20 mm below calyx. Flowers single or rarely paired. Sepals oblong, 20–30 mm long, 10–15 mm wide, tapering to a rounded apex, outer 3 coriaceous, inner 2 membranaceous. Corollas campanulate, bright yellow, glabrous 4–7 cm long, tube about 4 cm long and 7–15 mm in diameter, flaired portion about 2 cm long and 3 cm in diameter, apex usually entire, seldom lobed. Stamens 4, 1 much longer than others, up to half as long as corolla. Anthers somewhat twisted and lobed at each end. Filaments glabrous and dilated at base with upper half covered by crinkled hairs. Stigmas biglobose and adjacent to anther of tallest stamen. Ovary bearing 4 ovules and embedded in a 5-lobed cuplike nectary. Capsule tan, thin walled, rupturing irregularly, fragile, glabrous, globose, 3–4 cm in diameter, 1 locular, 4-valved, subtended by 3 accrescent and somewhat persistent sepals which enlarge to 5–6 cm in length. Seeds black, 1 per capsule, held in position by a 1 mm wide black strap connected at each end of hilum and causing formation of a longitudinal groove on dorsal and lateral sides of seed, oblate, 2–3 cm in diameter, black velutinous with pubescence soon dehiscent, bearing large seallike silvery or slightly discolored hilum on ventral surface and an impressed cross on ventral surface with outer seed coat black throughout up to 0.7 mm thick (thinnest near hilum) bony composed of at least 2 layers, inner seed coat yellowish tan 3.5 mm or less thick (thickest under hilum) soft leathery apparently homogeneous surrounding endosperm and lining cavity, endosperm whitish soft becoming gelatinous when wet and markedly increasing in volume, cotyledons 2 separated by a central cavity convoluted folded pale yellow. Imbibing seeds swell to twice diameter of a dry seed causing seed coat to fracture irregularly. Radicle emergent at hilar notch and elongating rapidly. Cotyledons hypogeous. Seedlings grow rapidly (up to 15 cm in a 24-hour period), with slender not self-supporting stem bearing at least 6 soon deciduous green recurved hooklike leaves about 1 cm long and less than 1 mm in diameter at intervals of 20 cm or less. First lamina bearing leaves on reflexed petioles are miniatures of adult leaves but with much longer tapering apices. Axillary shoots form in axils of large leaves. Two months after germination, tallest plant approximately 18 dm with largest leaf 5 cm long and 4 cm wide.[3]

Distribution: wet or mixed forests below 3,000 m from Chiapas Province, Mexico south through Guatemala to the Pacific side of Costa Rica, and on Hispaniola and Cuba.

Studied specimens: MEXICO: Chiapas:

[3] Live plants in Climatron (MO).

Breedlove 10166, 14.5 km N of Pueblo Nuevo Solistahucán along road to Tapuila (F), *Nelson 3262*, along road between Tenapa and Yajalon, alt. 900–1,525 m (US); Guanajuato: Duges, cultivated, garden University of Guanajuato (GH). GUATEMALA: Alta Verapaz: *Johnson 284*, road to Cobán from Chamá (US), *von Tuerckheim 744*, Pansamalá, alt. 1,150 m (US); Chiquimala or Alta Verapaz: *Watson 412* (GH); Huehuetenango: *Steyermark 49138*, Cerro Jolomtaj and *49110*, Cerro Cananá (F). COSTA RICA: *Burger and Matta U. 4766*, above Golfito on trail to television tower (F, MO, NY). HAITI: *Ekman 4698*, Pt. Louis du Nord, slope of Mt. Baron, alt. 500 m (K, US). DOMINICAN REPUBLIC: *Abbott 416*, Samaná Peninsula (GH pro parte, US) and *2404* (US), *Ekman H15169*, Laguna (NY). CUBA: *Eggers 4981*, Terviopelo (NY); *Wright 1657*, Hermitage and Cubana (GH) and *3080* (pro parte), Bayamon (GH, MO).

The number of studied specimens is indicative of the few herbarium sheets which have been collected. Their labels contain only meager field data. One of the best observations was made by Bill Burger, Field Museum, who remembered these details about the unknown liana (now identified as *M. discoidesperma*) he collected near Golfito, Costa Rica. The trailside tree was about 30 m tall and the liana was fruiting at the top of the tree. Fortunately an upper branch had fallen and was suspended about 7 m above the trail. The liana bore mature fruit and was essentially leafless. He was unable to trace the liana to its base because of the tangle of lianas and epiphytes on the tree trunk.

The difficulty in locating and collecting this liana may also be derived from the label of Abbott 2404. This collection was made from a fallen tree and his other collection from the same area in a different year was made from the top of a tall "trumpet" tree. Wright also noted the difficulty on his label 1657 when he recorded that the fruit "is found beneath well-known trees upon which ascends a vine or climber the character of which I do not know. I have seen it only in one locality, the Hermitage near the spring."

It is often difficult to separate species of *Merremia* from those of *Operculina*. Mary's-bean has been placed in both genera. Members of the two genera may be separated by a fruit character. *Operculina* fruits dehisce "at or above the middle by a circumscissile epicarp, the upper part is more or less fleshy and separating from the lower part" (Austin, in press). *Merremia* fruits either dehisce longitudinally by 4 to 6 valves or rupture irregularly. The fruit of *M. discoidesperma* ruptures irregularly. *Merremia* and *Ipomoea* may be separated by the presence of twisted anthers in the former genus and nontwisted anthers in the latter genus. Mary's-bean anthers are twisted (Fig. 7, B).

Flowering specimens of *Operculina triqueter* (Vahl) Macbride (*Operculina alata* (Ham.) Urban) have been incorrectly identified as *M. discoidesperma*. One easily seen character which separates these two flowering specimens is the bright reddish-brown calyx of *O. triqueter*. The calyx of *M. discoidesperma* is dull blackish brown to brown. When in fruit, the seeds of *M. discoidesperma* clearly separate this species from other species in the family.

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LITERATURE CITED

Austin, D. F. 1975. Convolvulaceae. In Woodson, R. F., and R. W. Schery. Flora of Panama. Ann. Mo. Bot. Gard. 62:157–224 Part IX, Family 164.

Bauhin, C. 1623. Pinax theatri botanici. Basel. 544 pp. (cf. p. 405).

Bauhin, J., and J. H. Cheler. 1650. Historia plantarum universalis. Yverdon. Volume 1, book 3, pp. 241–406 (cf. p. 330).

Carlquist, S. 1970. Hawaii, a natural history. Natural History Press, Garden City. 463 pp. (cf. Chapter 3).

Carruthers, J. N. 1956. 'Bottle post' and other drift. J. Inst. Navig. 9:261–281.

Clough, P. 1969. Voyage and untimely death of *Mucuna urens*. Gard. Chron. & New Hort. 1969 (June 6):4.

Clusius, C. 1605. Exoticorum libri decem. Rapheleng, Leiden. 724 pp.

Cuatrecasas, J. 1961. Taxonomic revision of Humiriaceae. Contri. U.S. Nat. Herb. 35:25–214.

Degener, O. and I. Degener. 1974. Flotsam and jetsam of Canton Atoll, South Pacific. Phytologia 28:405–418.

Dennis, J. V., and C. R. Gunn. 1974. Sea-beans: long-distance drifters from the South. Cape Nat. 3(3):40–45.

Docters van Leeuwen, W. M. 1929. Krakatau's new flora. In Stehn, C. E., W. M. Docters van Leeuwen, and K. W. Dammerman, Krakatau. Fourth Pacific Science Congress, Batavia.

Fairchild, D. 1930. Exploring for plants. Macmillan, New York. 591 pp. (cf. p. 332 + plate).

Gomez-Pompa, A. 1973. Ecology of vegetation of Veracruz. In Graham, A. Vegetation and vegetational history of Latin America. Elsevier, New York. 393 pp. (cf. Chapter 4).

Gumprecht, T. E. 1854. Zeitschrift dur allgemeine erdfunde, volume 3. Reimer, Berlin. 524 pp. (cf. Chapter 18).

Gunn, C. R. 1968. Stranded seeds and fruits from the southeastern shore of Florida. Gard. J. 18(1):43–54 + cover.

——, and J. V. Dennis. 1972. Stranded tropical seeds and fruits collected from Carolina beaches. Castanea 37:195–200.

——, and ——. 1973. Tropical and temperate stranded seeds and fruits from the Gulf of Mexico. Contri. Marine Sci. 17:111–121.

——, and ——. 1976. World guide to tropical drift seeds and fruits. Quadrangle/The New York Times Book Company (in press).

Guppy, H. B. 1906. Observations of a naturalist in the Pacific between 1896 and 1899. Macmillan, London. Volume 2. 627 pp.

——. 1917. Plants, seeds, and currents in the West Indies and Azores. Williams and Norgate, London. 531 pp. (cf. pp. 161–164).

Hemsley, W. B. 1885. Reports on botany of Bermuda and various other islands of Atlantic and southern oceans. In Thomson, C. W., and J. Murray (eds.), Report on scientific results of voyage of H. M. S. Challenger. Botany. Longmans, London. Volume 1, cf. pp. 276–313 + plates 64–65.

——. 1892. A drift-seed (*Ipomoea tuberosa* L.). Ann. Bot. 6:369–373.

Hobbs, K. 1969. *Entada scandens*. Gard. Chron. New Hort. 166(6):4.

Johnston, I. M. 1949. Botany of San Jose Island (Gulf of Panama). Sargentia 8:1–306.

Jonston, J. 1662. Dendrographias sive historiae naturalis de arboribus et fruticibus tam nostri quam peregrini orbis libri decem. Merian, Frankfort. 477 pp.

Kamerling, Z. 1911. Botanische excursies in de omgeving. Teysmannia 22:112–130.

Kotzebue, O. 1821. Voyage of discovery into the South Seas and Beering's Straits. Longman, Hurst, et al., London. Volume 3, 422 pp.

Leon, H., and H. Alain. 1957. Flora de Cuba IV. Contri. Ocas. Museo Hist. Nat. La Salle No. 16:1–556 (cf. p. 229).

Lindman, C. 1882. Om drifved och andra af hafsstrommar uppkastade naturforemal vid norges kuster. Gotesborgs Kongl. Vet. Vitt. Sam. Handl. 18:1–105.

Lloyd-Jones, A. 1893. A drift-seed from Swansea Bay. Kew Bull. 76–77:114.

Mason, R. 1961. Dispersal of tropical seeds by ocean currents. Nature 191:408–409.

Morris, D. 1895. A Jamaica drift-fruit. Nature 35:64–66.

——. 1899. A Jamaica drift-fruit. Nature 39:322–323.

Pena, P., and M. de L'Obel. 1570. Stirpium adversaria nova. Authors, London.

Pennant, T. 1809. A tour in Scotland, and voyage to the Hebrides in 1772. In Pinkerton, J., A general collection of the best and most interesting voyages and travels to all parts of the world. Longman, Hurst, et al., London. Volume 3, 919 pp.

Petiver, J. 1702. Gazophylacii naturae et artis, decas secunda. Author, London. 81 pp. + 50 plates.

Richards, A. 1958. Transpacific distribution of floating pumice from Isla San Benedicto, Mexico. Deep Sea Res. 5:29–35.

Ridley, H. N. 1930. Dispersal of plants throughout the world. Reeve, London. 744 pp.

Sachet, M.-H. 1962. Flora and vegetation of Clipperton Island. Proc. Calif. Acad. Sci. 31:249–307.

Safford, W. E. 1905. Useful plants of the island of Guam. Contri. U.S. Nat. Herb. 9:1–416.

Schimper, A. F. W. 1891. Indo-malayische strandflora. Fischer, Jena. 205 pp.

Seeman, B. 1854. Botany of voyage of H. M. S. Herald, under command of Captain Henry Kellett, R.N., C.B., during years 1845–51. Lovell Reeve, London. 483 pp. + 100 plates.

Sloane, H. 1696. Catalogus plantarum qua in insula Jamaica. Author, London. 275 pp.

——. 1698. An account of four sorts of strange beans, frequently cast on shoar on the Orkney Isles, with some conjecture about the way of their being brought thither from Jamaica, where three sorts of them grow. Phil. Trans. 19:298–300.

Smith, J. D. 1889. Undescribed plants from Guatemala VI. Bot. Gaz. 14:25–30.

Treub, M. 1888. Notice sur la nouvelle flore de Krakatau. Ann. Jardin Bot. Biutenzorg 7:213–223.

U.S. Navy Hydrographic Office. 1947. Atlas of surface currents northeastern Pacific Ocean. H. O. Publ. 570:1–12.

——. 1950. Atlas of surface currents northwestern Pacific Ocean. H. O. Publ. 569:1–12.

van Zualuwenburg, R. H. 1942. Notes on temporary establishment of insect and plant species on Canton Island. Hawaiian Pl. Rec. 46:49–52.

Vazquez-Yanes, C. 1971. La vegetation de la Laguna de Mandinga, Veracruz. An. Inst. Biol. Univ. Nat. Autón. Mex., Ser. Bot. 42(1):49–94.

Vincent, D. M. 1957. Tropical flotsam is profuse on North Island beach these days. Christchurch Star-Sun, April 2, p. 12.

Wallace, J. 1693. Description of the isles of Orkney (J. Small [ed.], reprinted 1883 by Brown, Edinburgh. 251 pp.).

——. 1700. Description of the isles of Orkney (J. Small [ed.], reprinted 1883 by Brown, Edinburgh. 251 pp.).

Williams, L. O. 1970. Convolvulaceae. In Standley, P. C., and L. O. Williams, Flora of Guatemala. Fieldiana: Botany 24:1–236 (cf. p. 73).

——. 1973. An antivenin, a pacifier and a bit of botanical sleuthing. Econ. Bot. 27:147–150.