be grafted into the top of a selected mother tree. Bloom panicles, inserted into bottles of nutritive solution, could be fastened to the mother tree, and replaced frequently. It should be remembered, however, to use only a monoembryonic variety as pistil or mother tree; the pollinator may be either mono- or polyembryonic. In regard to desired qualities in the mother variety, all present day monoembryonic varieties are so mixed in inheritance it is impossible to find pure strains for breeding, and therein lies the gamble—mostly a matter of luck.

To date all the numbers fruiting have been monoembryonic, yet the nineteen Edward x Pico hybrids are—theoretically—of 75% polyembryonic inheritance. It is not reasonable to draw conclusions from such a small number, yet certain impressions are gathered. The first impression—that polyembryony may tend to be recessive—comes from the fact that three of these Edward x Pico hybrids which seemed, from their cluster fruiting, and from shape, flavor and texture of flesh, to be completely Philippine in character—but with monoembryonic seeds although second generation hybrids of Philippine influence. The second impression—that the factor for polyembryony may be stronger, and more transmissible, in the wild No. 11 mango than in the Philippine Pico or Carabao—comes from the fact that the Haden variety—a Mulgoba x No. 11 natural hybrid—has a tendency to carry dwarf seedless fruits to maturity while true monoembryonic varieties shed seedless, or improperly pollinated, fruits at an early stage of development. Further, the Simmonds variety—a Haden x Carabao hybrid—is polyembryonic. It is also a second generation hybrid of theoretically, 95% polyembryonic inheritance. This may be merely a point of academic interest at present, I do not see how the No. 11 can be of use in a breeding program. Should the Haden variety be considered of merit for future hybridization it may be worthwhile to also consider the Simmonds variety as pollinator in an effort to improve fruit setting of the Haden through increased polyembryonic influence.

THE MANGO IN FLORIDA—1887 TO 1962

H. S. WOLFE

University of Florida

Gainesville

The beginnings of mango growing in Florida are shrouded in uncertainty. We know that Henry Perrine's plan for starting mango culture, along with that of other tropical fruits, was frustrated by his death in an Indian raid in 1840; the mango seedlings in his little nursery on Indian Key never lived to bear fruit. There is also a statement made in 1889 by Rev. J. R. White that he planted mango seeds brought from Cuba on Merritt's Island in 1855, but neither he nor anyone else records whether these seeds became bearing trees.

The first successful planting of mango seeds of which we know was in 1861, when Dr. Fletcher planted seeds of the No. 11 on the old Gilbert place along the river in what is now Miami. Barnes and Faulkner in 1868 planted seeds of Peach mango in Snapper Creek hammock, near Miami, resulting in large bearing trees also. We have no further record of planting on the East Coast for 20 years, but over on the West Coast we know that in 1872 Capt. McKay brought a small No. 11 seedling from Cuba to Bradenton, where Mrs. Warren planted it in her yard. And in 1877, W. P. Neeld planted seeds of No. 11 at Point Pinellas (the extreme tip of the Pinellas peninsula), followed two years later by planting seeds of the Apple mango. All of these seeds, both East Coast and West Coast, came from Cuba.

We are fortunate in having Pliny Reasoner's survey of the status of tropical fruit culture in Florida in 1887, the year before our Society was founded, as a base for comparisons. Yet it is evident that he was not familiar with what was going on across the state on the other coast. He knew of many plantings on the lower West Coast and wrote of there being 1000 young mango trees at Point Pinellas, with almost as many at Bradenton and Ft. Myers. Incidentally, he stated that prior to the freeze of 1886, there were 15 large bearing trees "between the Manatee River and Kettle Harbor," and these must have antedated even Capt. McKay's introduction. Together with almost all other mango trees north of Ft. Myers, these were killed by the cold of January 1886. But evidently there were mangos still thriving along the shores of Lake Worth, for when U.S.-D.A. Pomologist H. E. Van Deman visited there

in the spring of 1889, he found several large trees which had borne a crop the previous year, and at least one bearing tree in Palm Beach.

You may wonder why anyone would want a thousand seedling mango trees in 1888. The answer is that seedling mangos from Cuba and Jamaica were coming into the markets of the large Atlantic seaboard cities and were fetching prices then considered good. Growers in Pinellas County were finding it possible to ship fruit north and sell it at even better prices. One man reported sale of the crop from 11 trees bearing in their fourth year for over $200. That was a lot more money 75 years ago than it is today.

All bearing trees in Florida in 1888 were seedlings of Cuban origin, either No. 11, Peach or Apple types, but already efforts had been made to introduce superior types from the ancestral home of the mango, India. In 1885 Rev. D. G. Watt of Pinellas had imported at great expense eight grafted plants of two superior varieties, but five were dead on arrival and another was so weakened by the rigors of the long trip that it died in a few weeks. Two survivors were still vigorous and were planted with high hopes, only to be killed the next winter by the freeze. Reasoner Brothers offered grafted plants of three imported Indian varieties in 1888, but these were propagated from seedlings of seed received in 1887. It is, perhaps, just as well, in retrospect, that none of these trees ever lived to bear fruit, for the quality would undoubtedly have been very disappointing. The varieties of which seeds were sent were not of the best quality, and seedlings from them would probably have been very poor. But the freeze of 1894-95 carried them all off before they bore. Herbert Beck of St. Petersburg also imported grafted mango trees from India in 1888, but while we are told that the trees arrived in good health, there is no record of their ever having borne fruit. We must assume that they, too, died in 1895 before fruiting.

We start the initial year of our Society, therefore, with several thousand small seedling mangos and a few small grafted trees on the West Coast, while on the East Coast there were bearing seedling trees in the Miami and Palm Beach areas, though not in great numbers. There had been a few bearing seedlings in Hillsborough, Orange, and Polk counties, but presumably all of them had been killed in 1886. Propagation by approach grafting was being practiced on the West Coast for Indian imports, but no one had attempted selection among seedlings since they came so true from seed as to make vegetative propagation unprofitable.

Pomologist Van Deman had come to Florida early in 1889 largely to see how mangos were thriving. He had received many letters asking that the U. S. Department of Agriculture undertake the rather expensive importation of superior mango varieties from India, and he wanted to be sure of what would happen to them if imported. His old friend, Elbridge Gale, had given up his position as Professor of Horticulture at Kansas State Agricultural College in 1884 because of ill health, and had settled in the salubrious climate of the region along Lake Worth, below Palm Beach. Here he had become the leader of an enthusiastic group of horticultural amateurs, and it was they who had urged the introduction of better mangos. Impressed by the way mango trees had survived the '86 freeze, and by the gardening ability of the growers, he returned to Washington and ordered from the government nursery in Bombay grafted trees of six varieties. Received in Washington on November 1, 1889, the shipment was forwarded to the Rev. Mr. Gale at Mangonia for distribution to his group of growers. We have no record of how many trees there were of each variety, and there may have been only one. We have no account, either, of their condition on arrival at Lake Worth. From the fact that none had borne fruit by the end of five growing seasons, we may suspect that they arrived in very weak condition. At any rate, only a single tree survived the freeze of 1894-95, a tree cared for by Prof. Gale himself, and it must have been frozen back severely, since it took three more years to bear the first fruit. The writer has previously discussed the mystery surrounding this variety and the possibility (though not probability) that the tree was killed below the bud and that the tree which finally fruited was a stock sprout. At any rate, in June of 1898 this tree matured fruit for the first time, and the fruit was so high in quality as to justify fully the tales told by travellers of the deliciousness of the Indian mangos. From this point on, importation by the U. S. Department of Agriculture, by nursery companies, and by individuals proceeded apace.

The mango grower of 1888 seemed untroubled by problems of either pest control or fertilization, or of fruit setting for that matter. The seedling trees thrived in the thin sandy soil of the Pinellas peninsula and Lake Worth's shores with whatever fertilizer was given them. Seedlings often began to bear in four years from seed and bore heavy

annual crops. There was some infection of fruits by anthracnose, especially in the No. 11 type, but with trees widely scattered this disease was not a limiting factor. Black-spotted fruits were accepted as normal, just as apples were expected to have some worms. Quality was low, but until the Mulgoba fruited in 1898, there was no higher standard of comparison than another fibrous seedling. There was good demand in 1888 for seeds and seedlings of these mangos for planting.

The discovery in 1898 that mangos need not be fibrous immediately put a premium on quality and dampened the enthusiasm for seedlings groves, although it was several years before a supply of nursery plants of superior varieties was available. In 1899 the newly appointed Agricultural Explorer of the U.S.D.A., David Fairchild, sent grafted plants from Trinidad of three varieties esteemed there. Two years later the U.S.D.A. had eight varieties sent from Bangalore, India, and nurseryman John Beach imported another group of varieties from Bombay. Another big lot of scions was sent from Poona by David Fairchild in 1902, while in 1903 and 1904 the Royal Palm Nurseries made very extensive imports from Saharanpur, India. Altogether in the first ten years after the Mulgoba first fruited, over 60 varieties were imported, some of them several times and in a few cases the same variety under different names. By 1910 many of these introduced varieties had come into bearing and it was apparent that some were rather inferior quality, Indian nursery catalogs notwithstanding, and those of high quality were shy bearing. There were still many dozen varieties listed in India which had not been tried, but it was felt that the best ones had probably been introduced. And perhaps of equal importance in shifting interest from India to Florida was the first fruiting of Haden in 1910. Before dealing with Haden, however, a word about propagation is in order.

In 1888 the only method of vegetative propagation used successfully with the mango was the approach graft, commonly but inaccurately termed "inarching." This was true in India as welle as in Florida. John Beach stated in 1911 that he had used shield budding successfully on mangos in 1887, but had found no trees worthy of vegetative propagation; and when he brought back scions from Jamaica in 1889, he could get no buds to live. W. P. Neeld reported having budded a few seedlings in 1893, but the freeze killed all the budlings. H. J. Webber put on record in 1900 having seen 200 budded seedlings at Gale's little nursery at Mangonia, but for some reason Gale preferred to propagate Mulgoba by a modified form of approach grafting. The first person to bud mangos commercially in Florida was undoubtedly George B. Cellon, who used not shield buds but patch buds. In December, 1900, Cellon took a budstick from an inarched Mulgoba tree owned by Charles Parry of Miami and obtained by him from Gale. From this budstick Cellon inserted several patch buds on seedling stocks, and these united and later grew successfully.

There is a tantalizing uncertainty as to why Cellon used patch buds. It is possible that this was because he had patch-budded pecans in his former nursery in Alachua County, but he had also used shield buds on thousands of orange trees. In the early part of 1900, Horace Knight of Australia had published in the Queensland Agricultural Journal an account of his success in propagating mangos by patch budding. It is entirely possible that someone in Miami took this journal, that Cellon had read Knight's article, and that this is why he used a patch bud when everyone else had used a shield bud if budding was tried. But there is no possible way of proving the matter now, one way or the other. Until 1909 Cellon continued to use patch budding in his mango nursery, while Reasoner and Beach used approach grafting, but in that year Orange Pound of Coconut Grove demonstrated to Cellon that shield budding was quite satisfactory for mango propagation, and Cellon used this method thereafter.

Somewhere around 1920, veneer grafting was introduced into nursery propagation of mangos, but nothing in the literature gives a clue to who started this innovation. It is my guess that it may have been W. J. Krome, in his new Coral Reef Nursery, for he was an experimenter. Particularly in field nursery operation, this type of grafting was more reliable, or gave a higher percentage of "takes," than budding. In 1945, Cooper and Furr called attention to the advantages of the cinchona veneer graft over the standard type, and this method has entered nursery practice. Five years later, Lynch and Nelson developed a method of side-grafting very young mango seedlings, so that many months may be saved in the time between planting a seed and producing a budling for setting out. This they called "chip-budding," and it has also become standard nursery practice. Thus we see that we now have four or five reliable methods of propagation available today, in contrast with the rather clumsy method of approach grafting

which alone was known to be feasible 75 years ago.

The first fruiting of the Haden tree in 1910 started a new deal in mango culture in Florida. Hitherto all interest had centered in importing fine varieties from India, but by 1910 it was being realized that in spite of an occasional good crop, such high quality varieties as Mulgoba, Paheri, Borsha, and Alphonse were going to be unproductive in Florida. Suddenly a new variety, originating right here in Florida, offered a promise of better things. The fruit was more beautiful than any imported variety, it was larger than any of them with outstanding quality, and it seemed to be borne abundantly. Cellon at once grasped the possibilities of this Mulgoba seedling and began to propagate and sell it as the Haden. The fact that it was slightly fibrous and not of top quality meant nothing in consideration of its size and color, and only long years of experience brought the realization that it, too, was very erratic in bearing habit when planted in solid blocks.

Since 1930 there has been increasing interest in Florida seedlings as the source of new varieties, an interest fostered and expanded by the Mango Forum since 1938. There are probably fewer varieties in the state now—though still too many—than there were in 1910, but we now have quite a number which are better for commercial planting than Haden. There is still room, however, for a mango of high quality, attractive color, and regular heavy-bearing habit.

Fertilizer studies on mango trees have not made a great deal of progress, but we can utilize basic studies of nutrition made on oranges with considerable assurance that they will apply to mango. Thus, minor element deficiencies were recognized and corrected for mangos after being studied in citrus trees, and the high ratios of potash to nitrogen formerly considered desirable are now recognized as wasteful. We have knowledge of the time when flower bud differentiation takes place in mangos, but have not been able to utilize this in planning fertilizer schedules. Our major problem has been getting flowers to set fruit, rather than getting the flowers, and apart from the benefits of maintaining trees in a good state of nutrition—especially as regards the nitrogen level at blooming—we have not been able to influence setting by fertilizer practice. In this regard we are worse off than 75 years ago, in that fruit setting was no problem, but that was only because they grew only inferior but prolific seedlings.

Pest control troubled those pioneer growers very little, but as mango trees became numerous and solid plantings of many acres were made, pests multiplied and posed problems for the growers. The first pest of which we read complaints was a fungus disease attacking the mango blossoms in 1893 in Pinellas County, with a still more serious epidemic in 1894. The "big freeze" prevented any injury the next year, but by 1901, when P. H. Rolfs took charge of the federal Subtropical Laboratory in Miami, this disease of the blossoms and the black spotting of any fruit which set were very prevalent. He identified the causal organism and recommended Bordeaux mixture for control. It is perhaps worth calling attention to the fact that the year after our Society started its existence, a young man who was later to be very active in the affairs of the Krome Memorial Institute began his scientific career by setting up spray experiments with the newly developed fungicide, Bordeaux mixture, for the U. S. Dept. of Agriculture. This was David Fairchild. Through all the years since 1893, this fungus has continued to be the most important mango pest. Following Rolf's pioneering work on control of this disease, Harry Stevens carried on investigations from 1913 to 1936, while from 1933 until his death this past summer George Ruehle has been the leader in mango disease control. To him we owe especially the finding that much weaker mixtures than the old 4-4-50 were effective and that other copper compounds with less residue were equally effective and caused less development of scale insects. Today we can say that while control of pests is an important item in the cost of growing mangos, no pest is really a limiting factor in production.

One problem that we have today, but which did not exist in 1888, is the shipping of immature fruit. There was no incentive then to pick green fruit because there was very little fruit going to market. This is by no means a problem peculiar to the mango industry now, but it is one of concern to mango growers. There is no simple, quick test of maturity which can be applied to mangos, as pressure tests can be to apples and pears, or size by a given date can be to avocados. The only reliable test of mango maturity is the beginning to ripen of a fruit, but we have learned that when some fruits begin to ripen normally, all fruits from the same bloom period are mature enough to ripen satisfactorily if picked, although it might be several weeks until some of them began to ripen on the tree. This is not a point of much interest to the man determined to put man-

gos on the market ahead of anyone else and thus skim the cream of high prices. It is doubtful that anyone ever shipped immature mangos—or grapefruit, for that matter—in honest ignorance. But the conscientious grower no longer has to wait until each individual fruit begins to color before he feels safe in picking it.

In 75 years the mango industry has grown from the shipping of a few barrels of *fibrous* seedlings to marketing thousands of lugs of fine quality varieties. The major problem not yet solved is how to get good yields regularly, which means mostly how to get good setting of fruit from the abundant bloom. May the problem soon be solved!

BLACKBERRIES FOR CENTRAL FLORIDA

P. J. WESTGATE AND R. B. FORBES

Central Florida Experiment Station

Sanford

The blackberry trials at the Central Florida Experiment Station were started in 1956 by Dr. John W. Wilson in a cooperative experiment with Prof. Ralph H. Sharpe and Dr. J. S. Shoemaker of the Fruit Crops Department, Gainesville. Sharpe had crossed Regal Ness, a Texas blackberry, with our native dewberry *Rubus trivialis* to produce the hybrid I-3 in 1953. I-3 was open pollinated, and produced 100 seedlings, including No. 7, No. 24, and No. 77. From the original fourteen lines on trial at Sanford, some were soon eliminated, while others began to show superiority. The result was that one line, seedling No. 77, was named Flordagrand, and released to nurseries for commercial production. It had yielded 8 pints per vine of large, high quality berries at Gainesville, and had made satisfactory growth and yields at Sanford. Flordagrand is described (1) in Florida Experiment Station Circular S-112 (December 1958).

The Flordagrand trial at Sanford was expanded in 1959 from the original small plots to a planting of about one-third of an acre of this one variety. From time to time other selections have been added as the experimental trials continue. Yield data from these trial plantings for the past three seasons are presented in Table 1 and Table 2.

Yields fluctuate somewhat from year to year. Some lines appear to do better than others in dry years in comparison to wet years. No. 3-80 appears to produce better berries in semi-shade. The generally lower yields in 1962 could be blamed partially on the dry weather. However, the trend seems to be toward a general decline in vegetative vigor, as well as yields in the 1956 planting. The average useful life of such a planting is estimated at 10 years (Circular S-112). One factor in the decline now under investigation is nematode injury. Dr. H. L. Rhoades, at the Central Florida Station, found sting and stubby-root nematodes infesting the blackberry roots in these trials. Experimental work is underway to determine the extent of damage and means of control. These pests are very destructive on vegetable crops in this area.

Insect and disease damage has been light. One year thrips and mites infested the plantings, but were controlled with parathion. Botrytis fruit rot occurred one season. Control measures suggested by Dr. J. F. Darby (Associate Plant Pathologist, Central Florida Experiment Station) include sprays of neutral copper or captan.

A blotchy red color may develop on ripe fruit if it is left in the sun for any length of time after picking. This injury is avoided if fruit is taken directly to the packing shed and kept out of the sun.

After the Flordagrand was released and isolated plantings were made, it became evident that this variety is not self-pollinating (2) but must have pollen from other varieties to set fruit. Nurseries propagating this line now include plants of another "pollinator" variety with each order of Flordagrand.

At present, some of the numbered lines are yielding more than Fordagrand and are being considered for release. A new Texas berry which looked good this season is Brazos. This berry comes in later than those of the Flordagrand type and thus extends the harvest season about one month. There was some "double blossom" noted in Brazos last year, but no sign of the disease was noted this year. Fruit size and quality were excellent. This variety is self-fertile, and continues to set fruit when no other blackberries are in blossom. The canes are semi-erect, making it unnecessary to trellis the plants.

Public acceptance of these new blackberries