Gathering Gold Dust

by Philip J. Savage, Jr.

It is unfortunate that so many accurate and descriptive old "sayings" become changed in popular usage through ignorance of their true meaning. One of these is the "Story of the Bees and the Flowers." For many generations, this was the first step into the sex education of the very young. If well told, it supplied not only the basic plan of all sexual reproduction, but emphasized its beauty and purpose. Now that Playboy magazine has taken over the sex education of the very young, and the average dweller in Megopolis knows little and cares less about nature's ways, the logic of the old story has been totally missed, and the cliche has become "the Birds and the Bees," said with a knowing wink and a nudge. With the possible exception of the African Honey Guides, Kingbirds, and an avian family known as "Bee Eaters," there is little interaction and certainly no reproductive assistance between birds and bees. Between bees and flowers, on the other hand, the connection is basic.

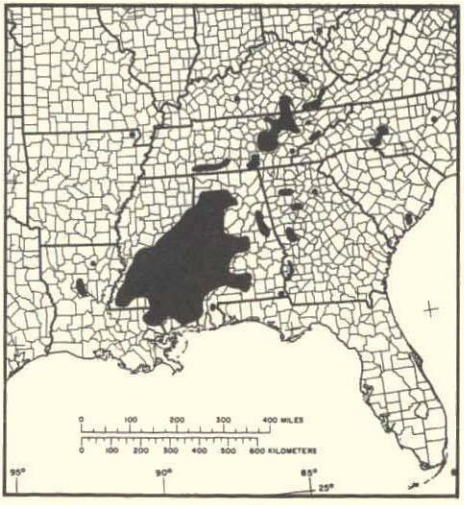
The "busy" bee is easily seen to be an excellent pollen carrier. His pants pockets contain visible bags of it. His (or rather its) furry body is thoroughly dusted with the stuff. You see him on his "appointed rounds," like an (old fashioned) mailman, going into and coming out of the flowers that attract him, all day long, from early spring until late fall.

The fossil record indicates that the most primitive flowering plants, the older forms of the *Magnoliaceae*, evolved many million years before the bees and wasps (*Hymenoptera*) and must have depended on older insect orders as their mobile Cupids. Fossils of even the earliest of the *Magnoliaceae*, show clearly that they were adapted to insect pollination, so as long ago as the Cretaceous period, insects of one order or another must have been doing the job.

In an almost worldwide temperate to subtropical climate, the *Magnoliaceae* proliferated over almost all the land areas of the Northern Hemisphere, no doubt taking some pollinators with them, while encountering and adapting to others throughout the Miocene and well into the Pliocene periods. Cooler and drier intervals, of course, occurred, and the wider swings of climate must have severely tested the viability of the plant and insect species, as well as the unknown creatures that aided in the dissemination of the amazingly uniform seeds. Extinction of genera and species must have been widespread, for although some magnolias could adapt to severe cold, the mark of the rain forest was always on them, and even narrow belts of steppe and desert would prove uncrossable barriers.

Time and again, as millennia rolled by, chronic droughts and frigid cycles blighted the northern regions, battering the *Magnoliaceae* back to their two great, unchanging bases; the rain forests of southeast Asia and the Americas. Better times would launch them north again for a few hundred thousand years, and always the northern fringe of species pioneered the relatively tiny amount of evolutionary change that has taken place in this great, successful, and extremely self satisfied family of plants.

Most flowering plants go to considerable trouble to see that their bisexual flowers are not self pollinated. Magnolias have developed protogynous flowers in which the stigmas mature and are receptive to pollination first, but are no longer receptive when the anthers of that same flower release their pollen, from several hours to several



Magnolia macrophylla (big leaf magnolia)

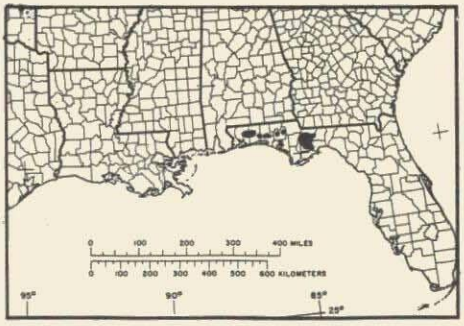
days later. Although this system avoids inbreeding, it demands that the same individual insect be attracted to that species' flowers at both stages of their sexual cycle. In flowers that have nectaries, this is easily accomplished, but the *Magnoliaceae* do not seem equipped to produce nectar. Many insects come to feast on the abundant pollen, a high protein food, but what attracts pollen bearing insects to the freshly opened flowers at the "female only" stage? Flowers at the female stage have a great deal more fragrance, and this certainly attracts me, but you don't see the bustling activity you would expect of such fertile flowers.

While sitting beside flowering sweetbays on warm June evenings, at dusk, I have often noticed insects running at racehorse speed, up the main trunks and branches and out onto the flower bearing twigs. Each twig is explored with evident purpose. If it holds a newly opened flower, the speed merchant is up, over and down into the blossom in an instant. In four or five seconds it re-appears, dashes down the twig and locates another newly opened flower. Dusk is the time of a sweetbay blossom's strongest scent, and scent seems to be the guide by which these intelligent acting insects determine the worth of a particular flower. If the bloom on a twig tip is a "second nighter," the insect abruptly turns back when only halfway out from the main branch, and seeks another. Catching one of these track stars last year took some doing. A dive off the twig always avoided my grabbing hand. Finally successful, I took the prize into the house and identified it (tentatively) as *Parcoblatta*, a native cockroach! I couldn't find a speck of pollen on this individual, or any damage to the flowers I had watched him visit. Although these insects did not appear to eat or gather anything, they were evidently rewarded in some way or they wouldn't enter flower after flower. By the same reasoning, the reward must have been consumed, or they wouldn't leave! On their second opening, sweetbay flowers have much less scent than "first nighters," but contain heaps of protein-rich pollen, which would seem ideal food for a hungry roach. Why didn't *Parcoblatta* visit them? The frantic but businesslike hurry of these roaches intrigues me. They have the same workaholic quality bees have, if you can imagine pedestrian, nocturnal bees!

Roaches are old, older than beetles, far older than bees. Roaches are mostly nocturnal and mostly tropical, as are the greatest number of magnolias of sub-genus *Magnolia*. I am planning to spy on Speedy Gonzalez more closely next June.

The large beetles that you see going into magnolia flowers (June beetles, Rosechafers, Japanese beetles, etc.) simply move in and wreck the joint. They cut odd shaped holes in the tepals, munch aimlessly on stamens and stigmas alike, carry on repulsive orgies and often die, clumsily, on the velvet tepals, a better fate than they deserve. They fail totally to give the impression of busy pollen carriers going from flower to flower.

Little beetles are a different story. It is almost impossible to collect open magnolia blossoms, or even stamens, without bringing into your house a perfect zoo of hyper-kinetic little beasts that bail out of the flowers as you prepare them, fly like tiny bullets toward windows, hide like partridges, and if not destroyed at once, return and eat every single grain of the pollen on your collecting paper. I do mean every grain of it. I sometimes receive from friends a folded packet of waxed paper containing a dozen or more stamens of some favorite magnolia, plus a tiny stowaway beast. You can depend on it, there will be no pollen in that packet at all. Somehow, such voracious pollen destroyers don't seem like benevolent creatures carrying on a mutually beneficial symbiotic relationship with the summer blooming species of magnolia, any more than grazing cattle seem like effective pollinators of alfalfa. In any case, whether the job is done by roach or tiny beetle, it is done extremely well. Seldom is a single carpel seedless, year after year, in all but one of the species of subgenus Magnolia in my garden. That one species is the early blooming *M. fraseri*. It blooms too early for beetles and roaches, and somehow doesn't seem to be attractive to wasps and bees. No doubt

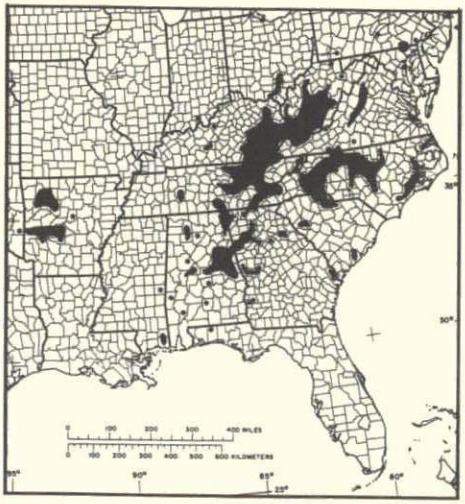


Magnolia ashei (Ashe magnolia)

in its temperate mountain homeland, pollen vectors occur that can't abide Michigan.

The aim of all life seems simply to live, and Mother Nature seldom bankrupts a going concern. If beetle pollination is highly successful, there is no pressure to change. (See p. 21 in the Spring-Summer 1977 Newsletter, with notes from, "Morphogenic Stagnation in the Evolution of Magnolia Flowers," by Dr. E. E. Leppik). In looking through herbarium specimens of tropical *Magnoliaceae*, I find it interesting that there is considerable variation in individuals, but surprisingly little variation in what have been determined as species, and even as genera. Primitive evening-flowering, evergreen magnolia and manglietia species still rear mighty trunks in timeless tropical rain-forests of southeast Asia and Indonesia, exactly as they did many million years ago. Some ultra-conservative experiments are noticeable in having ripe carpels split dorsally, or ventrally, or all the way round, or not at all. In the rain forest gang, this seems to have kept the research department happy, or at least on the payroll.

In the classification of species and genera, taxonomists search for, and are delighted to find, a certain characteristic that runs through a large group of species. Dr. Alfred Rehder divided magnolias into those that bloom before the leaves appear, and those that bloom with, or after, the leaves. This left two species, *M. acuminata* and *M. liliflora*, in a shadowy twilight zone between two sub-genera. It remained for the late J. E. Dandy of the British Museum of Natural History to note that the only really consistent physical difference between the two groups could be seen when the anthers on each side of a stamen split open lengthwise to release their pollen. All magnolias accomplish this in one of two ways. In the greater number, by far, these openings both face toward the center of the flower, like a figure 11. Typical of this huge group is *M. virginiana*. The anthers on a stamen of *M. acuminata*, on the other hand, split along the outside edge on either side, with the openings facing away from each other. In *M. virginiana*, then, most botanists say the anthers dehisce introrsely, and it thus belongs in sub-genus *Magnolia*, while in *M. acuminata* the anthers dehisce laterally, and it belongs in sub-genus *Yulania*. Under Rehder's classification we had a comfortable and long existent bridge between the two sub-genera, in the numerous

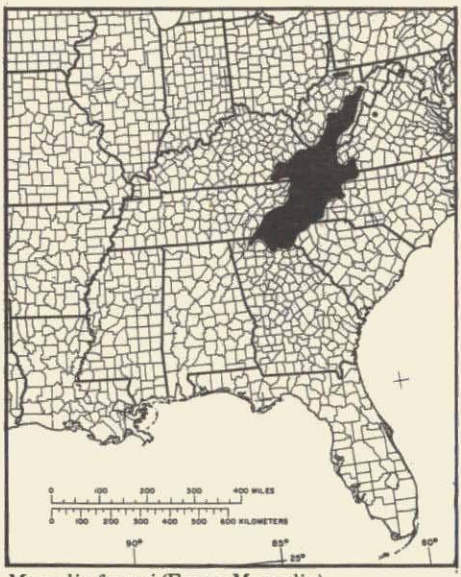


Magnolia tripetala (Umbrella Magnolia)

hybrids of the *Soulangiana* grex. Dandy's reclassification puts both parents of this hybrid group in sub-genus *Yulania*, so for the present, at least, there appear to be no bridges, although there is a distant sound of hammering and sawing coming from the U. S. National Arboretum, where Frank Santamour is working to build one.

Dr. John Hutchinson's "The Genera of Flowering Plants," 1964, Volume One, contains the most up-to-date listing and descriptions of the currently accepted genera in the family *Magnoliaceae*. Dandy re-edited and published this chapter, with permission of his friend Dr. Hutchinson, and both men were kind enough to allow our Society to reprint the edited form in our Newsletter, Vol. 8, No. 1. New Members who do not have a copy of this Newsletter, or those who want additional copies, may purchase them from our secretary-treasurer, Dick Figlar.

In addition to the magnolias of sub-genus *Yulania*, only three genera, *Michelia*, *Paramichelia*, and *Tsoongiodendron*, have anthers that dehisce laterally or sublaterally. In these three genera the flowers are axillary, that is, the flower buds are formed in the axils of that year's leaves. While this arrangement is not found, to my knowledge, in sub-genus *Magnolia*, I believe it occurs in *Yulania*. Vigorous shoots of *M. kobus* var. *stellata* in several forms, *M. liliflora*, and *M. acuminata* var. *subcordata* often develop flower buds in nearly every leaf axil. Some botanists regard such buds as terminal, because they are produced on the ends of abbreviated twigs, or



Magnolia fraseri (Fraser Magnolia)

peduncles, one millimeter or less in length, and they feel truly axillary flower buds would be sessile, without peduncles. The flowers on my *Michelia doltsopa* appear to have peduncles also, just to confuse the issue, or at least to confuse my interpretation of the issue.

Although *Paramichelia* and *Tsoongiodendron* agree with *Michelia* in producing axillary flowers having the gynoecium stipitate, they differ sharply in the form of their fruit clusters, with *Tsoongiodendron* closely resembling *Talauma* in this regard, and *Paramichelia* resembling *Aromadendron*. In any case all of them are regarded as "derived" types, with fewer primitive characteristics than *Manglietia* or sub-genus *Magnolia*.

One interesting group in the Magnolia complex was designated as section *Maingola* by Dandy in 1948. (Curtis Bot. Mag. clxv sub 16). The ten existing species Dandy felt belonged in this section are found over a really enormous range, from north latitude 28 degrees (and 8000 feet) in northern Assam and Burma, to 10 degrees south of the Equator in Java, or almost the entire length of the great rain forest. Among several points of interest in this group is the shape of the fruit, which is cylindrical and usually somewhat distorted, and thus very similar in appearance to typical fruits of species in sub-genus *Yulania*. A further item of note is that the gynoeciums of some of the species are short stalked, as in *Michelia*. This could lead us to speculate that perhaps the ancestors of the species in section *Maingola*, Dandy, were also ancestral to both *Magnolia* sub-genus *Yulania* and *Michelia*. While not cylindrical, the fruits of at least the section of *Michelia* to which the species *doltsopa* belongs have widely spaced carpels with a generally distorted shape. I personally feel strongly that the species of sub-genus *Yulania* are much more closely related to *Michelia* than to sub-genus *Magnolia*.

Why a comparatively small number of species, and these among the more advanced in evolution split their anthers laterally, prompts some conjecture. Did the development of the *Hymenoptera* as pollen carriers demand a change in anther dehiscence more suitable to this family of insects? Were other changes in tepal color, scent, and tepal movement developed to capitalize on the boundless energy of these diurnal workers? Were certain magnolias and michelias thus able to climb the slopes of the rapidly upthrusting Himalayas and bloom much earlier in the chilly spring than nocturnal beetle and roach schedules allowed? I think so.

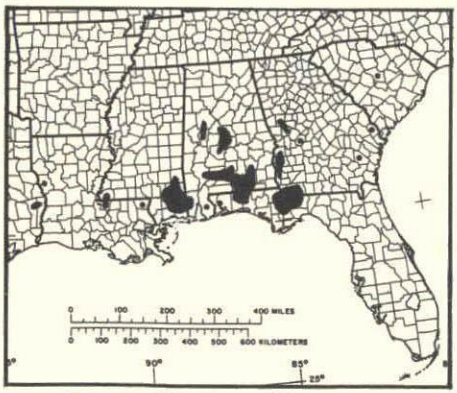
The earliest magnolias to bloom here in Michigan are *M. salicifolia* and *M. kobus borealis*. When these species open their flowers in the bright spring sunshine, they are surrounded by a perfect cloud of tiny wasps and native bees, whose effectiveness as pollinators is seen the following fall in branch-breaking loads of seed. The stellata group, slightly later, draws the same crowds. In my cool greenhouse at that time, *Michelia doltsopa* is past peak bloom, but with the top vents open, the few remaining blossoms are buzzing with brilliant little wasps and bees. It is worth noting here that individual *doltsopa* blossoms last almost two weeks before they shatter or discolor.

It is certain that the tiny wasps and bees are not attracted to these early flowers by the direction in which the anthers dehisce. Scents attractive to the *Hymenoptera* no doubt evolved concurrently with lateral dehiscence, but most important of all is that these are daytime flowers that open in the bright noonday sun to attract daytime wasps and bees. Surprisingly, the lovely Yulan, with its powerful lemon scent, attracts few bees and wasps and so sets very little seed under natural conditions in the new world. Herbarium specimens from China have fruits packed with

seed, so it would appear we don't have the proper bees or wasps a-wing at the time the Yulan blooms in America.

Fortunately, we do have pollen carriers in the Occident as efficient as Chinese wasps, and whose efforts can result in Yulan fruits as large as small bananas, with every carpel filled. I refer to *Homo magnoliaphilis*, whose numbers, once endangered, are rapidly increasing. I belong to this subspecies of *sapiens*, and hope you do too. On the cover of Newsletter Vol. IX, No. 4, Oct. 1973, is a picture of hand pollinated Yulan fruits resulting from the use of *M. cylindrica* pollen. Seedlings from these are now eight feet tall, with very pretty leaves, but have not bloomed as yet.

The equipment needed to become a dedicated pollen freak is simple but essential. First of all, you should develop some kind of daydream of your ideal magnolia. Plant type, foliage, flowering season, flower color and shape and cold hardiness are all attributes to consider and compromise. If all the world's magnolias would cross, and if mature plants of all the species were available to you, what magnificent cultivars you could create! Even with 25 hardy or near hardy species, all in cultivation, the combinations are mind-boggling. Remember that plant breeding is by no means limited to the production of hybrids. It is every bit as important to produce and select superior forms of true species both for their own merits as improved ornamentals, and for use as breeders in the development of really outstanding hybrids at a later date. Rhododendron hybrids of the grex Loderi, produced by crossing very carefully selected forms of *R. griffithianum* and *R. fortunei* in the garden of Sir Edmund Loder, are vastly more spectacular in flower and plant than hybrids of the same cross, bred from less outstanding parents some dozen years earlier, at Kew. Obviously, all our plans must be adjusted to the availability of high quality, blooming age breeders within a reasonable distance, to allow for close observation and use.



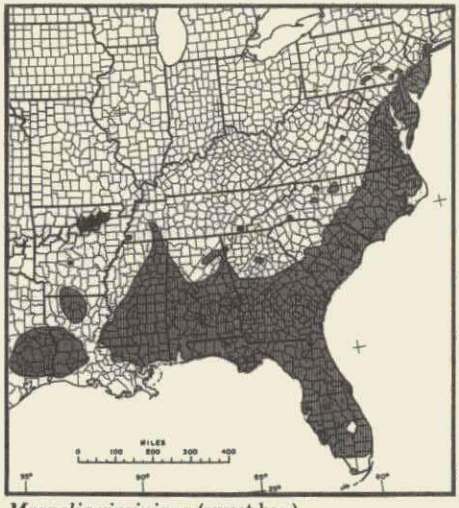
Magnolia pyramidata (pyramid magnolia)

With fantasy-land behind you, it is time to go shopping, and your first stop could well be a good office supply store, where you should buy 50 or more small white paper envelopes, like little letter envelopes, with a well glued flap for sealing. The ones I get are 1 3/4 inches high by 2 7/8 inches wide, and white. Yellow pollen shows up well against white paper, so you can see, and use, all of it. While you are at this store you can also get a half dozen water-color paintbrushes of a fine, "thin-line" type, with variously colored handles; 50 or more heavy paper shipping tags 3 1/4 by 1 3/4 inches with reinforced eyelets, and a ball of good hard-surfaced tie cord for the tags. Your next stop should be a high grade garden supply store, to get a 1 1/2 pound can of "Flower Dri," a silica gel dessicant. If the garden supply store doesn't stock and can't get this product, and your florist has never heard of it, calcium chloride (Dowflake) can be used. This is usually called chloride of lime in Canada and the U. K. The smallest bag of Dowflake is 25 pounds, about a ten year supply, and Flower Dri is much pleasanter to use, and more effective. You will also need a glass jar with a tight-sealing cap. I use old instant coffee jars simply because I drink freeze-dried coffee for breakfast.

The early blooming species like *M. salicifolia, kobus*, the cultivar 'Merrill,' and the like are probably the most difficult magnolias from which to obtain large amounts of pollen. They are difficult only because cool days and frosty nights may keep them in long but tight bud for ten days, and on the first decently warm day (while you are at work) they pop wide open and shed all their pollen in an hour. If these flowers are gathered too early, the stamens shrink and harden and the anthers never open. If they are picked too late, by just an hour, not a grain remains. The safest course, with these early birds, is to gather 10 or 20 flowers a day, around noon, when the stamens are just beginning to move away from the central column of the gynoecium. A reading glass is a great help in avoiding flowers whose anthers have already dehisced, since the zipped-open anthers are easily seen.

When you are gathering magnolia flowers for their pollen, pick a lot of them. I usually fill a medium sized waste basket, and astonish the neighbors by standing for long periods with my head buried in this homely receptacle, inhaling the delicious perfume. Steeling your heart against the sacrilege, sit down on the porch steps and gently break off every last beautiful tepal, right at its base. The aforementioned zoo of tiny beetles can zoom off and find other blossoms outdoors, where they belong. A somewhat overlong thumbnail is an excellent tool for picking magnolia flowers. Pushing this into the tender pedicel, just outside the tepal bases allows you to break the buds off, rapidly and cleanly. It also gives your thumb a semi-permanent brown color, which can act as a conversation piece for your friends. When your wastebasket load of blossoms has become a cereal bowl of de-frocked parts, and the captains and the kings of your beetle zoo have departed, enter your house and spread several sheets of white letter paper on a table or windowsill in a quiet room with as little air movement as possible. With knife, shear or trusty thumbnail, sever the gynoecium straight across, even with the tips of the stamens. All this is intended to do is provide a flat base on which to stand your flower parts, upside down, in orderly rows on your clean, white papers. Write the species or cultivar name on that paper, right away, without fail.

If you have accomplished the foregoing with attention to detail, and a bit of gardener's luck, the following day will show circles of golden pollen on the white paper, underneath the upside-down stamens. Carefully move the flower parts, still upended, to another sheet of clean white paper. Put a very gentle fold, not a crease, in the pollen covered paper, making a chute in which to concentrate your pollen by very gentle tapping on the outside, former bottom, of the paper. After writing the name of the pollen producing plant, plus the date and any other pertinent data on one of your little white envelopes, hold it open with a finger while you insert the corner of your paper chute into the envelope. Gentle, repeat gentle, tapping on the bottom of the chute will slide your golden treasure into the envelope. Spread your paper chute flat again, and pick up the flower parts you set aside, one by one, and tap them on the paper. A small additional amount of pollen can thus be collected, for chuting into the same envelope, which should then be sealed. Scotch tape

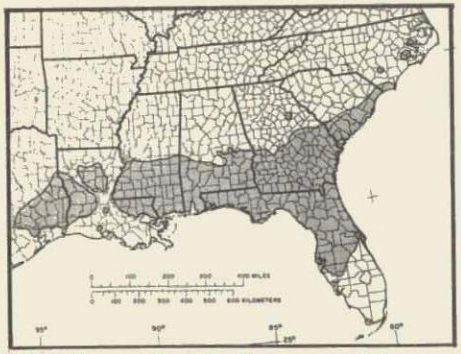


Magnolia virginiana (sweet bay)

over all seams and leaky corners is a good safeguard. Don't let the dessicant into the envelope!

Having obtained a good, tight sealing glass jar, like a four to eight ounce freeze dried coffee jar, fill it half full of Flower Dri, lay your envelope or envelopes of pollen on top of the latter, screw the cap on tightly, and pop it in the fridge. The lowest shelf is a preferred spot. As many as 50 envelopes of pollen can be kept until needed in such a jar. If you have to use calcium chloride, put a layer of cloth or Kleenex on top of it, before you put in the pollen envelopes.

In working with species of the more primitive sub-genus *Magnolia*, the hybridizer's task is considerably easier. The weather is more predictable; the flowers are produced over a longer period of time, and their male and female schedules are such that you don't have to quit your job to be home when the action starts. With a few exceptions, species of this sub-genus follow the pattern of tepal movements seen in *M. virginiana*, the sweetbay. This is the type species of its sub-genus, and although its selection for that distinguished position was on the basis of priority, rather than a "Typical Magnolia" contest, it is hard to imagine a better choice. Northern sweetbay buds open for the first, or female, stage, about 4:30 in the afternoon, Sun Time, and close again five or six hours later. You can pick these flowers the following morning, prepare them as discussed



Magnolia grandiflora (southern magnolia)

above, and have a bumper crop of beautiful pollen waiting for you that same evening.

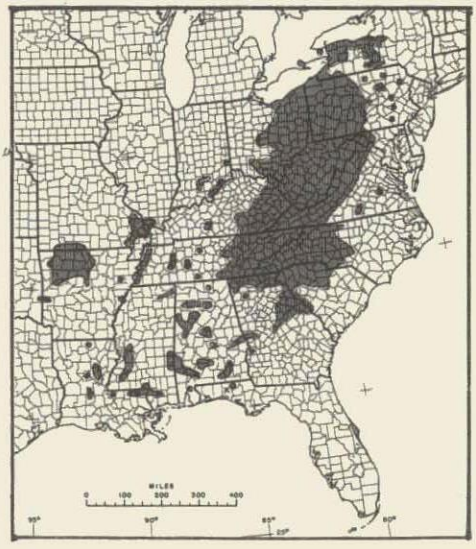
It is hard to realize that pollen grains are not spores, or merely sperm cells; they are a complete male apparatus. That envelope in the coffee jar contains millions of male magnolias, as potent as stallions and as hardy as polar bears.* It is a marvelous idea. Unfortunately, no matter how virile the stallion, he gets nothing but a kick in the jaw unless the mare is receptive. To determine with accuracy when magnolia stigmas are receptive is almost the whole secret of magnolia breeding.

Look over the magnolias you intend to use as seed parents, and spot the buds that look promising, are within reach, and will open within a day or two. Make mental, or preferably paper notes of them. Between 11:00 a.m. and noon look at them again, and this time have with you a sharp pruning shear, an envelope or two of the pollen you have planned to use in this cross, a color coded watercolor brush for each kind of pollen, some shipping tags, a pencil, and your ball, of strong, hard surfaced twine. Don't get fibrous sisal, wool, or mason's twine. These don't stay tied outdoors. Get the small hard strong stuff that makes a knot you can barely untie. A prime bud is down to its last perule. The tepals are in sight on half the flower, but the last thin, papery, brown perule, thinly pubescent, still covers part of the bud.

With your sharp pruning shears, or a knife if you prefer, cleanly slice off the pointed tip of the bud. You should plan to have a hole, about as big as a wooden pencil, through which you can dimly see the gynoecium, as fresh as a new laid egg. The stigmas will be curled back, or really out and down, and their upper surface will glisten, as if covered lightly with colorless gelatin.

Slice a corner off your pollen envelope (it's usually windy, and pollen blows like talcum), put in a brush, twirl and withdraw it and quickly insert it in the hole in the top of the bud. You won't be able to see past your brush handle, but move it around gently to reach as many stigmas as you can. Now, like a surgeon closing a wound, cut off a piece of twine eight or ten inches long and tie the top of the bud tight enough to be completely closed. On stubby buds this takes a bit of doing, as your suture tends to slip up and off the top. Make a loop with half a reef knot, slip it over the bud about a third of the way down, and tighten. When the top hole closes, with the twine cutting into the tepals just a trifle, complete the other half of the knot. If you can't close the opening at all, you sliced off too much of the bud.

If the flower has stiff, fleshy tepals that can't be drawn together, put a leaf over the opening and then tie it up. Cut or roll off the string in three or four days. I leave the tepals as they are but



Magnolia acuminata (mountain magnolia)

* The pollen grains can stand cold down to at least zero, but if a late freeze (32° F.) nips an open or pollinated flower, it will not produce a fruit and you can just hope there were a few late-opening buds not blasted, so you can repeat the cross with the unused pollen you have cannily put back in the icebox.