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About the Institute

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Hunt Institute was dedicated in 1961 as the Rachel McMasters Miller Hunt Botanical Library, an international center for bibliographical research and service in the interests of botany and horticulture, as well as a center for the study of all aspects of the history of the plant sciences. By 1971 the Library's activities had so diversified that the name was changed to Hunt Institute for Botanical Documentation. Growth in collections and research projects led to the establishment of four programmatic departments: Archives, Art, Bibliography and the Library.

General Bulletin

Algae - Cultivation

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In writing this bulletin, the authors have decided that it shall have two themes, one dealing with certain phases of the cultivation of azaleas under greenhouse conditions, the other treating of the same phases without the aid of greenhouse facilities. It will be seen after reading that the great difference between them lies only in the question of time, both time as related to the moment of action and time in its duration. These, of course, are interrelated, but, since all gardening activities are managed in relation to time, it seems reasonable to point this out at once as the explanation of certain inevitable repetitions. The senior author came to the cultivation of azaleas much as might any amateur, with no former experience and with no facilities for propagation other than a cold frame; the junior author brought to his work years of experience in greenhouse work. Each has learned more as the work progressed.

For most amateurs the word azalea means either some one of several wild species native to his area, some exotic species purchased from a nursery, or a tender plant to be had of a florist usually in mid-winter at the time of its flowering under glass. This is only a partial knowledge of what the word may mean or what the group includes.

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Originally the word azalea was both a popular and a technical name but the continuing study of botanists and taxonomists has shown that now the word azalea must be considered only as a popular term for certain groups of species within the great genus Rhododendron.

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That genus is very large with an estimated _____ species. The great center of the family lies in the Orient with China as its (core ?) and populous branches extending southwest ^{through} into India, less numerous groups extending northeastward into Japan with outliers in the Philippines, some few westward through Asia Minor and the Caucasus to Europe. In the North American continent, the smaller group is found on the Pacific slope with an extension into Alaska, and the larger group on the Atlantic coast with similar though distinct groups of species for the lower altitude seaboard area and the mountains of the Alleghenies. As might be expected, these areas of distribution are not too sharply defined and overlapping areas are often sought out by the discerning botanist-gardener especially in the northern limits of the range since often he may safely assume that northern examples have a cold tolerance that might not be expected of other material from the southern extensions. This assumption is not absolutely safe since it is believed that some southern species may be represented now only as vestiges of once larger and more widely distributed populations.

The azaleas themselves vary enough so that botanists have arranged them in several groups that appear to have certain characteristics in common, but there are even yet some doubts about a few of the species in the less well known groups, as well as some uncertainties about the interrelation of species within each group. These need not be of special concern to gardeners until these doubtful plants have been better studied both in the wild and under cultivation.

As a point of departure, the azalea might be described as a shrub, varying in height from a few inches to over 15 feet, occurring at all altitudes from almost sea level to mountain tops but usually related to latitude as well, preferring acid soils rich in vegetable matter and usually well drained, found most often in colonies or in close association with other shrub masses, most frequently as woodland plants, though coming out into the open at high altitudes or near sea level in the far north and surviving with varying degrees of prosperity under adverse conditions that are often almost the opposite of those described. They show varying degrees of cold tolerance under cultivation and their original home is not always a safe indication of hardiness. Though less often remarked in garden writing, they also show marked variations in tolerance of summer heat, both in degree and duration. Their foliage is as diverse in size and shape as their stature; it may be deciduous or evergreen with varying degrees of semi-evergreenness, dependent usually upon location. In technical books much is made of the variation of leaf character in the evergreen species with the designations of summer and winter leaf types. This is of no great significance to the gardener but is chiefly of use to taxonomists studying herbarium sheets. The evergreen leaves appear to be of one year's duration and those that are produced in the spring and early summer when the plant is actively growing are usually larger, often thinner in substance than those produced in the latter part of the summer as twig growth slows down for the formation of the terminal flower buds. These are covered with scales for the winter and are usually subtended by smaller leaves with widened petioles that approximate the formation of the bud scales. If one examines the flowering ^{shoots} roots carefully, he may often find a complete series of forms from normal leaf to scale. On non-flowering shoots there is the typical reduction in size as summer advances but no diminution into the near-scalelike forms. The flowers are produced, according to the species, from late winter or very early spring until midsummer though in cultivation, under some conditions, stray flowers are produced at other times, a fact that will be discussed later, particularly under some of the species in the Obtusum Sub-series. (See page). The flowers are produced

from the flower bud formed the preceding summer and occur singly to several from each bud, the buds themselves being solitary or grouped so that the flowers may appear to be in large heads, like those of garden rhododendrons. This tendency to produce grouped flower buds is most common on young plants or on vigorously growing shoots. Various exceptions will be noted in the descriptions of the several species. In normal flowers there is the usual calyx with five lobes that vary greatly in size and character, a corolla with five, often unequal, lobes united to form a broad salver-shaped corolla or to make a starry face to a long and often slender tube. The stamens vary from 5 to 12 according to the species and are often prominent, giving the same sort of effect that one finds in Nerine or Lycoris among bulbs. The pistil may be long or short, again depending on the species. The anthers open from apical pores and the pollen spills out in stringy masses. It is usually ready to fall as soon as the flower opens and about one day before the stigma is ready unless there is unusually hot weather. The common variations in azalea flowers are two, modification of the calyx into petal-like substance so that it appears like a second corolla and forms the type of flower known in garden literature as hose-in-nose. True doubling appears in various degrees, most commonly in garden clones. Winglike appendages of petal tissue appear at the base of the stamens, or on the anther sacs, and/or the entire filament of the stamen may become petal-like with a split corolla or without vestiges of the anthers on the margins. There are some garden clones in which all degrees of modification may appear in a single bush. In more complete doubling, the pistil and ovary are transformed into colored petal tissue, rarely with tiny vestiges of green ^{leaf} petal-like bits in the center. The corolla is usually of one color, though there may be darker tinting on the outside. In most species, there is a color variation on the uppermost corolla lobe that may take the form of a stain of color or may be made up of tiny dots or marks that resemble inverted Vs or Us, with the color pattern sharply defined or diffuse. There are garden forms in which there are stripes or borders of darker color on the lighter ground, but the senior author is not certain of the record of their origin, though they appear to have come into cultivation to Europe from the Orient as garden plants, a fact true also of certain white and scouble

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forms. Seed sets freely on most normal flowers and the seed pods grow quickly to full size. The seed is not ripe until the autumn, when the onset of cold weather breaks the woody capsule along the sutures so that the 5 locules stand free of the central placental axis, allowing the light, almost chafflike seed to scatter. Seeds vary in size according to the species; some are smooth and some slightly winged, neither of which facts has much significance to the gardener.

There is considerable variation in the habit of the azalea bush. Some species, as for example, Rhododendron atlanticum, spread by underground root stocks from which rise the flowering shoots to form a wide mat of growth. Nearly all in nature produce one or more stems from the base that may branch freely, as in the Kurume azaleas or sparsely as in the Royal azalea, R. schlippenbachii. This characteristic branching becomes more pronounced as the plant ages, since it usually makes its vigorous growth to form the skeleton of the future mature shrub and then produces the frequently very twiggy lateral branches and branchlets forming the dense plant habit so prized in gardens. The density of these twigs and the ultimate height of many species and garden forms is frequently influenced by the amount of shade given, with looser and taller growth as shade increases. There are few data from field botanists on the effect of altitudes, but the original description of the low dense habit of the wild forms of Kurume azaleas, growing at altitude of about

feet, appears to have given a wrong concept of their stature. In the senior author's experience, plants taken from over sunny sites, with no excess of humus or moisture and placed in good azalea soil in half shade, immediately altered their dwarf twiggy habit and produced long shoots, typical of azaleas grown in woodland. This discussion of habit is important to the gardener, not only for the effect the shrub will have, but also for his understanding that the adult plant he may raise himself or that he may buy, particularly in small sizes, may require several years before they show the nature character of twig formation that determines the character of the flower mass; the twiggy the plant, the more flower buds possible and the more solid the color effect. This is shown in its ultimate form in the carefully trained specimen plants of florist's azaleas, which when in flower hide the leaves under the blossoming.

Azaleas have been prized by gardeners in many countries and for many reasons. Their most obvious appeal lies in the prodigality of their flowering under good culture, the very wide color range possible by choice, the reasonably long flowering season, in some cases for the fragrance and generally speaking their ease of culture, provided certain basic requirements are provided. Eventually, the azalea specialist comes to the place where he can forego all of these factors and enjoy acutely the beauty of the individual plant and blossom in which there are almost infinite number of beauties to be observed and cherished.

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The history of the azalea as a garden plant is very largely complicated by the fact that there were large numbers of hybrids produced in Europe immediately after the introduction of the North American species and that some of the Asiatic azaleas first introduced ^{there} were garden forms, perhaps hybrids in some few cases, with the result that in the garden literature of the time, the first half of the 19th Century, there was incomplete understanding of the material itself and a popular terminology that is now in need of revision. This revision must be based in part upon deductions and these, based upon personal opinion, are always partly suspect. In this paper where ^{beliefs} opinions are offered, they will be noted as such, otherwise comment may be considered as the result of study and observation for more than a twenty-five year period, unfortunately only under one set of climatic conditions though on varying terrains and with some basic soil differences, but with field observations elsewhere.

As nearly as can be determined, the earliest horticulturists set to work upon the species, whether native or introduced, to improve them. Their attention seems to have been centered primarily on the flowering and the flower itself, the first to be altered either in season or abundance, the latter to be improved in color, size, form and substance. Improvement in seasonal bloom appears to have had its greatest attention in Europe and especially in Belgium where there evolved a somewhat mongrel race of azaleas, the earliest representatives of which are grown ^{we get} in our Southern State as outdoor shrubs, the "Indian Azaleas" and the later developments, as tender-to-cold florist's plants amenable to forcing with flowering according to clone and commercial demand from Christmas until early April. The development of this latter race was contemporaneous with the development of greenhouse construction in Europe and one may safely deduce from the garden journals and other writings that the development of relatively few clones, easily responsive to heat in winter, diverted the attention of the hybridizers from hundreds of plants of great beauty produced earlier, now lost because they did not fulfill the arbitrary and limited requirements of the forcing trade. And since the plants themselves apparently were not suitable for outdoor planting in northern Europe, the production became more and more specialized. It is probably idle to surmise what the ancestors may have been or the steps that produced the present-day somewhat homogenous race. The senior author accepts the responsibilities for his conjectures offered later (page).

Improvement in size and color concerned the European breeders who combined the American native azaleas with the single European representative of the same group, R. ^{u m}luteas, a plant that resembles our own wild species in general characteristics, but has clear yellow flowers with a deeper yellow blotch on the upper lobe and a delightful scent. The progeny of the crosses with our native R. nudiflorum, roseum, calendulaceum, speciosum and perhaps others gave the race of plants commonly known as the Ghent azaleas. While distinguished amateur collectors of the period undoubtedly maintained specimens of the species themselves, our American plants, missing our hot summers and cold winters, never figured in popular appeal as did their progeny from the European R. luteum.

The later introduction of R. molle from China and still later of R. japonicum from Japan gave the European breeders materials for altering the size and character of the flowers still further. These two Oriental species have salver-shaped ^{florae} flowers with widely opened faces and not the long tubes of the species cultivated earlier. Their progenies preserved this flower form very largely and took up something of the wider color range available from American species particularly in the reds available from such plants as our flame azalea.

Of the two latter species, R. japonicum is probably the more amenable to cultivation in this country as the Chinese species is somewhat tender to cold and certainly is impatient of our long hot summers. There is little evidence that there is much stock of the true species in this country, but its progenies and allies are to be seen at their best in our Pacific Northwest with its moist, lukewarm climate, neither too hot nor too cold, a condition easily comparable to the garden conditions of Great Britain and the northern parts of Europe. Work has already begun to breed a parallel race to these "Ghent-mollis" or "Ghent-japonicum" hybrids in which there will be little or no blood of our mountain species but only that of the natives of our southern coastal plain, plants already inured to long hot summers and short variable winters.

It should be evident from this that plant breeding activities have been centered upon a relatively small number of species and there should be no surprise that these are somewhat specific in their culture preferences. It has been suggested, and there are considerable data to support the suggestion, that plant breeding will become more and more of a local activity and that the best plants for a specific area will be those born and bred within that region.

Except for certain areas and probably under the impetus of regional enthusiasms, species azaleas have never played a major part in American shrub planting. Of the species enumerated and briefly described in the appendix, only about are regularly listed in our own nursery catalogues. A search of specialists' lists in some years may yield as many as others. For others, one must either collect from the wild or raise from imported seed.

	nudiflorum	vaseyi	Schlippnebachii
	roseum		poukhanense
	calendulaceum		Kaempferi
common	austrinum		obtusum (Kurume)
	occidentale		mucronatum
	viscosum		indicum
	arborescens		phoeniceum
			scabrum
			reticulatum

	speciosum	luteum	quinquefolium
	canescens		linearifolium (formas)
rare	atlanticum		
	alabamense		
	forms of calendulaceum	(Euberi - Bakeri etc. Cumberlandense)	

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There are some gardeners who insist that they find the greatest beauty always in the wild plant, presumably as "created." Only a few of these persons recognize the fact that the wild plants themselves vary widely in their characteristics, particularly in the dimensions of the flower or in the range and clarity of its color. ^{Some} ~~These~~ few collect and preserve these individual plants, but they rarely get them safely into general cultivation.

It has never been entirely clear to the senior author what these persons saw in the wild plant that made it more beautiful. The best argument, and one with some weight, is that by and in the process of "improvement" the special characteristics of the flower are modified, particularly by an increase in size of corolla, whether it is merely a matter of gross diameter or a broadening of the individual lobes. Certainly the most captious gardener would not deny the breath-taking loveliness of R. schlippenbachii, but even in any lot of seedlings there are variants that stand out above their fellows. Confronted by an equally large number of seedlings of R. reticulatum, however, no one could deny that the paler, rosier individuals or their slightly lavender forms catch his eye and hold it, while he quite turns away from the magenta that seems the abundant norm. Anyone travelling through R. nudiflorum country can not fail to note individuals that stand out above their fellow, for size of flower or clarity of hue.

Perhaps it is needless to point out that selection is always the forerunner to further steps in plant improvement.

Whatever the reason, the fact remains that ornamental plantings of species, with practically no exception, are far less frequent than those of garden races.

The natural areas in our country for general use of azaleas are those in which our native species occur. Within these areas, there still have to be proven which exotic species and garden races based on exotic species may be useful. The authors are unable to do more than offer the following suggestions. The two Korean species, R. Schlippenbachii and R. yedoense with its form R. yedoense poukhanense are quite hardy to cold. R. indicum, known commonly as Azalea macrantha, is hardier than is usually believed and, as it goes northward, tends to a lower growth habit that allows for snow cover and protection. The Kurume azaleas are somewhat less dependably cold hardy but, if planted as fairly large plants and given protection for a few years, will survive, well in some clones beside "amoena" which appears to be the hardiest. The related Kaempferi is hardy far north near the coast but is less dependably so inland. R. mucronatum is almost as hardy in the same area but suffers from flower bud injury rather more frequently than most, largely because it appears sensitive to alternations of temperature in late winter. The problem seems to be complicated by the fact that there may be more than one clone in cultivation under this name. This species suffers the further disadvantage of decreasing usefulness as it is taken far south, a difficulty for Kaempferi as well, except at some altitudes from the edge of the Piedmont inland. The many beautiful hardy hybrids produced by Mr. Joseph B. Gable of Stewartstown, Pennsylvania, using chiefly these species, lend weight to the belief that the above group must furnish the basis of northern plantings of exotics.

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Although there are few data, possibly due to less available stock, the Ghent azaleas are for the North rather than the South with relatively good reports for R. japonicum and some ~~sp./~~ for the European R. luteum.

Should there be a
Section here: treating

of all species of

Agavea — a d.

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Reference

Bulletin?

As yet there are not enough data to offer conclusive suggestions as to the use of the florist's azaleas in the open. They are being planted in some areas in the deep South, in southern California and elsewhere on the Pacific coast. Those observed by the senior author in Florida, South Carolina and southern Mississippi were not as luxuriant in their growth as other garden azaleas of the regions. Their derivatives, in the Rutherfordiana and Periclyt races, to be discussed later (page) gave much better performances but are by no means substitutes for the florist's plants. Their nearest rivals are their ancestors, the so-called Indian Azaleas of old southern gardens. These are of unequal merit, but many are excellent plants for any garden and some are much hardier to cold than once believed.

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This has not been done

Planting

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Assuming then that the gardener will content himself with planting those species and forms which he may reasonably expect to flourish under his conditions, what are the preparations he should make and the procedures he should follow?

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Soil preparation. This must be done as may be required by the nature of the soil or the premises. The soil that azaleas prefer must be acid in reaction, rich in organic material and free draining. Since most of the soils in areas where azaleas are native are acids, it is rarely necessary to do anything to acidify the soils. The organic material added to the mixture will usually give the desirable result, particularly if it is a partially decayed oakleaf mixture or one of the commercial peats of known acidity. Drainage is ~~something~~ something that must be arranged, but is ~~something~~ ~~that~~ rarely presents any difficulty unless the site is on an impervious clay. In that case the bed should be excavated to the desired depth and filled with the soil mixture. If the terrain is level, it may be necessary to have dug a ditch from the bottom level of the bed to a lower hole, and fill both ditch and hole with coarser stone so that they will act ^{as} like a dry well and take off quickly any excess of moisture that might have drained into the more permeable soil of the prepared bed.

The question as to how deeply the bed should be prepared is one that each gardener must settle for himself. The commonly cited fact that azaleas are "shallow rooted" is true only in part. If they occur in nature, the type of humus rich soil that they prefer is usually shallow, so the root masses spread laterally in the layer where their food is found. The senior author, gardening on his site that has a ^{meadow} shallow soil with gentle slope, spreads a layer of peat or leaf compost about six inches deep over the already deep ^{by dug} beds and then mixes it in, first with a digging fork, then with a trowel and finally by hand, choosing a time when the soil is fairly dry. This has proven entirely satisfactory, giving a mixture that preserves a uniform moisture throughout. Seedling plants when dug at the third year have root masses almost as large as their tops and certainly 12 inches deep. These beds require no watering after the first season. When more peat is used in the mixture, growth is excellent, but the peat dries out quickly on the surface and more care is needed to wet it, usually a light watering, followed by a heavy watering about a half hour later. A coarse mulch of less well decayed compost is an excellent addition to such plantings.

The next problem is the spacing of the plants. The senior author prefers to plant closely. Young rooted cuttings bought or dug from your own frame can be spaced 4 to 6 inches apart each way. Under ordinary growth these should touch each other by late autumn and go into the winter as an almost solid "ground cover". Their mutual protection both in summer and winter is hard to underestimate. Since they are easily transplanted, a new spacing the following year is easily accomplished.

The senior author prefers to have all planting beds made in midsummer and left idle until the following spring, when they are dug over once again. The action of the winter weather seems to have a happy effect ^{on} the soil mixture.

If the plants are to be used singly, the soil preparation is essentially the same and one must guard against the same difficulties. The senior author believes firmly in deep soil preparation and in his own garden used a three-gallon bucket of peat or humus dug into the ground in the base of the hole. The plant is set on this cushion and the sides are filled in with the soil from the excavation to which a less generous amount of humus is added. There is a basin left so that watering after transplanting time is easily applied. The only evidence that can be offered to support this theory of planting with deep soil preparation is that the plants have grown exceedingly well, that they rarely require watering or show signs of foliage wilting and that those few that have been dug up for discard have shown root masses that filled the entire space and beyond with strong structural roots through the mass of fine roots. In no case has it been found that the root mass did not go deeply into the prepared soil.

Planting and transplanting. Azalea plants usually are offered for sale, either as small plants from pots or plants dug with soil on the root masses and wrapped in burlap for shipment. At times one may buy "bare root" cuttings and from certain areas bare root plants. One may plant azaleas from pots or "balled and burlapped" at almost any time of year, weather permitting. The least desirable time for delivery of such material from the nursery is at the time when the new shoot growth is about half developed and correspondingly soft, but even this can be handled if one will watch the watering and provide temporary shade. Bare root cuttings should be ordered so that delivery comes early in spring before any growth has started or in midsummer when top growth is least active, assuming that these small plants are to be grown out of doors. Rooted cuttings in the opinion of the senior author should be grown on for one year in a cold frame for their best development in the Washington, D.C. area. They establish themselves well enough in open nursery beds, but there may be a high percentage of winter loss from bark splitting the first season. Farther south this probably would not be necessary. Larger bare root plants should be delivered and planted in the spring only. If they could be planted the first season in a cold frame in a soil with twice as much peat as is normally given, their reestablishment will be quicker than under ordinary care, even if special attention is given to water and shade. Seedlings and larger plants of deciduous species and varieties should be bought for spring delivery only.

In the foregoing paragraph, planting was discussed; in this paragraph transplanting is treated. The essential difference is that for this paper planting refers to general practice involving ^{improvement} improvement, but transplanting refers always to moving and ^{re}planting on the site. The deciduous species are best treated like any other deciduous shrub and transplanted while leafless, preferably in the spring before growth is active. Seedlings of deciduous species from pots can be set out as soon as the new growth has matured. Plants of deciduous species collected from the wild have been successfully handled even in summer by cutting off the tops to about 4 to 6 inches ^{above} the soil line and paying special attention to watering until new growth shows over the stems and from the base. Evergreen and semi-evergreen species can be moved about at almost any time but the authors prefer not to move the plants while new shoots are growing as that increases the amount of daily attention to watering.

Azaleas are much less difficult to handle than many have believed, and the attentions required for shade and water are as in any good garden practice. For shade, one uses^S whatever is available and convenient, provided only that free circulation of air continues. In nurseries, there are usually available portable frame units, 3 by 6 feet, with widely spaced laths, that can be set up. These are convenient but not necessary in small gardens. A few branches, with or without leaves, stuck into the ground are quite adequate. In watering, one must use more judgment. The principal thing is to have enough moisture in the soil so that the plant has always what it may need, to maintain its supply. If the soil is properly prepared, there is no danger of excess, and experience suggests that mere regularity in water is all that is needed. The senior author, employed during the day, waters his plants in the evening. Since he is concerned chiefly with small seedling transplants, hybrids of evergreen species, he waters them every day, twice on Saturday and Sunday, i.e., an early morning watering and one about sundown. This has kept his plants in active growth throughout the summer, but is discontinued in^{mid} September except for the week-end waterings. The only exceptions to this routine occur on those days when there is rain or in periods of gray weather when soil evaporation is negligible. The main purpose is to keep a uniformity of soil moisture if possible and, if observations are correctly interpreted, uniformity of moisture is much more important than degree of moisture. Azaleas can adjust themselves to almost any degree of dryness short of desiccation or of moisture this side of saturation, provided it is constant during the growing season. They appear to be damaged most by alternations of dryness and moisture. As autumn approaches, watering is reduced to check any tendency to shoot growth so that there will be as little soft growth as possible that may be damaged by first frosts. In the Washington, D.C. area, light frosts have little effect upon foliage and severe frosts (below 32° F.) damage only more slender shoots that are full of sap by breaking the very thin bark covering. While older plants seem capable of healing over slight breaks on bark tissues, young plants

are frequently killed because the entire bark is loosened from the wood, practically girdling the stem. If there is recovery, it comes from new shoots that arise below the injury, usually at ground level. The authors have never followed the practice of watering azalea plantings just before the onset of winter as is often recommended, because in this climate drought periods rarely occur in autumn and the plants normally go into the winter with adequate moisture content.

If there is any period in which watering is particularly necessary here in case of drought, it is during the months of July and/or August when the plants are forming the flower buds for the following season. This is most obvious in the deciduous species, and the senior author can report that he never succeeded in flowering his seedlings of R. Schlippenbachii until water was given in July and August of a very dry season.

It is reasonable to believe that gardeners in other parts of the country will work out the routine of watering proper to their own soil and climatic conditions, on the basis of these recommendations. The senior author, with limited experience with a planting in southern Mississippi on sandy soil, heavily built up with humus, can report that on that free-draining soil more frequent waterings are necessary to maintain continuous summer growth.

Watering

When once established, azaleas rarely need any watering unless the season has an extended period of drought. This is most damaging if it occurs in the period between the falling of the flowers and the completion of new shoot growth. If it begins earlier, as flowers are developing, these may develop well enough but are usually somewhat undersized.

For this type of emergency watering, any system that will provide an adequate soaking of the soil will serve, whether slow flooding of the ground or an overhead sprinkler system. If the ground has been properly prepared so that water is retained by the humus, one thorough soaking a week seems adequate here.

In those garden areas where small plants are being grown on, after transplanting from the propagation frames or greenhouses, regular watering will provide more uniform growth of new wood. The circumstances of each location will determine the best local procedures.

Under amateur conditions, watering will produce from three to eight small branches from each rooted cutting, whether home grown or purchased as a "liner." If the grower wishes to increase the branching, each of these shoots may have the top pinched out leaving about two inches of the shoot end, after a few weeks' delay, should produce new shoots from the axils of the upper two or three leaves. These may be pinched again but, under local conditions here, no pinching is advised after mid-August as there is not enough time for the latest growths to harden before frost.

Growth. It has already been intimated that any azalea bush has growth of several types, one that goes to make up the framework of the shrub, the other to provide the flowering branches. When the plant is young, its chief growth goes into the formation of the structure of the plant; as it matures, the number of short branches for blooming increases. As far as our observation goes, the production of all short growth is concentrated in the spring ^{following flowering} growing season. It has been observed, however, that strong shoots for the formation of the plant structure may come at any time during the summer. Particularly in young plants, rooted cuttings and even more markedly in seedlings, there is a production of new shoots from the crown, that is near the ground line of the original stem, in June. It has not been observed that any such shoot produced flower buds the first season, even if the top was cut off to check growth.

Feeding. In the work carried out here, there has been practically no fertilizer used, except at the display planting in the National Arboretum. There immediately after flowering (mid-June or early July) the following fertilizers have been given at the rate of about per acre.

The fertilizer is dusted over the ground and allowed to wash into the soil naturally. The results have been highly successful.

after the original deep digging of peat

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In the southern Mississippi garden known to the senior author, the sandy soil has been enriched not only by the continued applications of humus mulches but also by limited dressings of cow manure. Other fertilizers rich in available nitrogen, such as blood meal and cotton seed meal, have been applied after flowering and again in midsummer with excellent results. Occasional flushes of summer growth appear light green, though not with all chlorotic symptoms (see page), are brought back to deep green color by a light dusting of copperas over the ground.

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not done

In the Dutch work, "De Azalea Indica L.", Volume I of the Tuinbouw Encyclopedie (Amsterdam, 1938), fertilizers are discussed on the basis of their commercial availability, but the underlying principle appears to be that the plant should have a nitrogen rich complete fertilizer after flowering to promote shoot growth, with phosphates available for July and August to facilitate the formation of flower buds.

Apparently the azalea will accept almost any fertilizer provided its application does not bring about an alkaline reaction in the soil, provided always that it is supplied with its other physical requirements. The times of application are related to normal periods of active growth and the time when cold damage may possibly occur.

The problem that most frequently presents itself and that may be attributed either to improper balance in soil nutrients or to wrong fertilizer practice is the handling of chlorosis. This manifests itself in azaleas most commonly by a loss of green pigmentation in the leaves except for such green as may persist along the veins and the margins. According to _____, this results from non-availability of iron in the soil through the formation of insoluble iron-calcium compounds, in the presence of excesses of nitrogen. (VERIFY) Under greenhouse conditions, this is quickly corrected by _____ % solutions of ammonium sulfate applied to the soil, and out of doors with a dusting of copperas (Ferrous ^{sulfate} ?). In the somewhat limited experience of the authors, it shows up in the North, most frequently in poorly drained planting beds.

Verify

Experiments reported by Stuart (NIM, etc.) on the effects of specific elements upon azalea growth, show that

(get from NIM and have Stuart O.K.)

This type of difficulty has not arisen for either author of this paper.

45

Propagation. It has been the observation of the authors that nearly all the amateurs of their acquaintance sooner or later decide that they would like "to raise a few azaleas for themselves."

Since the principles are the same for either amateur or commercial production, they can be discussed briefly with notation of the modifications for small-scale production.

Seeds. Seeds of many species are available from commercial dealers in tree and shrub seeds. The fresh crop is gathered in autumn and seed may be purchased then or during the winter.

In nature, the seed falls to the ground in autumn, lies inactive during the winter and, here, germinates, if it has fallen in a likely place, during April and/or May, according to the warmth of the season. The senior author, working without heat, sows his seed in late March. The germination is always slow, 4 to 6 weeks, but growth is continuous thereafter. The junior author, working with greenhouse facilities, may sow seed at any time of year, but the preferred season is from the end of January to the middle of March. With temperatures of $^{\circ}\text{F.}$ (day) and $^{\circ}\text{F.}$ (night), the seed germinates freely and the seedlings are ready for handling.

Fresh seed under optimum conditions will germinate in from 2 to 6 weeks, depending upon the species. Experience has shown that the longer the continuous growing period for the seedling between germination and its first winter, the better the young plant.

In each case the seed are sown on sifted sphagnum moss, using the present version of the century old practice. Shallow flats are filled with chopped moss pressed down well. Over this is placed a layer of sphagnum sifted through a $\frac{1}{4}$ inch mesh screen of wire cloth. This, too, is pressed firmly so that the layer when finished is, at a minimum, $\frac{1}{2}$ inch deep. Some growers prefer this sphagnum layer over a flat of azalea soil, on the theory that the seedling roots penetrate the soil and survive better if transplanting is delayed. The authors have repeatedly kept untransplanted balances of seedling stands in the original pure sphagnum for over two years without loss, and the ease of handling the light weight sphagnum flat is considerable.

When the flat is properly prepared, it is set into a pan of water until thoroughly soaked and then stood on the floor until all excess water runs off. It is then ready for seed sowing.

476

The ease with which excess moisture drains out of the coarse sphagnum lower layer permits considerable latitude in the use of drainage materials. The senior author, working with small quantities of seed, uses ordinary wood flats and no drainage material at all. The junior author, working with metal flats, covers the bottom with a sheet of glass cloth that can be salvaged and used again more than once if desired.

prepared

The seed is sown on the surface ~~of the flat~~, the flat covered with glass and a shade of any suitable sort that gives about the same amount as one thickness of newspaper. The flats are stood on the bench or in the frame until the seed has germinated and the seedlings are ready for pricking out. No further attention to watering is needed for at least six weeks, when the flats can be lifted and set into a pan of water until suitable moisture has been absorbed. No excess need be feared, as it will immediately drain off when the flat is removed.

52

Seed may be sown broadcast or in broad lines. If one has ample space, broadcasting is preferable. The senior author has regularly sown his hybrid seed in broad rows with spaces of about one inch width between these rows. The only practical disadvantage to this method is that transplanting into flats must be carried on as quickly as possible ~~if~~ or the crowded seedlings will produce such long hypocotyls that one has some manual difficulty in disentangling them at transplanting time. One can become expert even at this. The only difficulty ever encountered has been in the cases of some hybrids with "macrantha" blood (R. indicum) and others with blood of R. scabrum. These fell over and rooted along the entire hypocotyl with the result that it was like disentangling grass sods to get them apart, but was accomplished tediously and with little loss.

Fresh seed germinates well. One year old seed, stored under room conditions, usually gives sufficiently good germination to warrant its use, if necessary. In one case only of a flat held over to a second spring was there any second germination. The only other unusual happening came in some commercial seed of R. calendulaceum in which there were two distinct mass germinations about two weeks apart. Unfortunately, no segregations were made from these two lots, as it would be interesting to know if the slower-germinating seedlings came from plants that bloomed later than others. Such a variation was noticed later in plants grown to maturity from this seed.

64

The important thing to remember is that the dry sphagnum must be new and that it can not be used for a second sowing, even if a new layer of sifted sphagnum is added. The common "damping-off" fungi can not live on the fresh sphagnum surfaces, but apparently they can infect an old flat, not in use, in which the sphagnum had broken down, lost its fibrous nature and did not drain well. The senior author learned this the hard way and lost an entire flat of hybrid seedlings by his attempt to save work.

55

Some workers prefer to sow seed on Vermiculite, but the authors prefer sphagnum, not only because of its light weight, its inhibiting of damping organisms, or because of the extreme ease of transplanting from it, but also because any remainders not needed for the first transplanting can be maintained in the ~~first~~ seed flat in health, in a state of semi-arrested growth for over ^{three} year^s. At times replacements are needed.

No worker should give himself the handicap of sowing on soil in which "damping-off" organisms live and thrive even better than azaleas.

Azalea seedlings are small but they are neither fragile nor delicate. Under greenhouse conditions, where shade, moisture and humidity can be kept more or less uniform, they may be transplanted from the germination flat to the first transplant flat as soon as the seed leaves are well formed, or they may be left until there are several true leaves. Under cold frame conditions, the transplanting seems to be less of a shock if they are left until there are several true leaves.

The soil for the transplant flat should be the same mixture that is recommended for full grown azaleas, acid in reaction, fibrous from organic material, quick draining and firmly packed down. The flat should be well watered and allowed to drain before use.

The seedlings are easily picked up with the fingers from the sphagnum. A knife blade or thin wooden stick, used like a dibble, opens a slit in the soil of the new flat, the seedling held in the fingers of the left hand is inserted in the hole and the opening closed by pressure of the fingers of the right hand. A little practice with unimportant seedlings will soon bring speed and proficiency. It makes no difference at what level the seedling is planted as the entire hypocotyl appears capable of producing roots from its entire length, ^{twice} It is not desirable to let the seed leaves touch the soil surface.

59

In greenhouse practice it has been found that seedlings, if spaced two inches apart each way, will make excellent plants in six months' time. No comparison is possible under cold house treatment as the senior author, with less space at his disposal, has spaced his seedlings one inch apart each way. They have grown excellently but usually produce few if any secondary shoots. The seedlings may be transplanted a second time with wider spacing if desired or may be left in these flats, stored in a cold frame or cold greenhouse over winter for transplanting out of doors into nursery beds the following spring. In many ways azaleas, during their first year, are much like many annuals and will respond to frequent transplanting and care with continuous vigorous growth. As a matter of experiment, the junior author transplanted a small set of seedlings, of several hybrid origins, into greenhouse benches and continued their active growth with the first flowering produced in 14 months from germination and general flowering within 18 months. Under good care out of doors, some flowering can be expected the third spring and general flowering the fourth.

As in all other phases of azalea growing, the more uniform the attention, and the better the soil preparation, the more desirable and immediate the returns. The experience of the senior author, working with ^{out} greenhouse facilities and in such time as could be spared outside of office hours, is that he can expect a lag of one year as compared to the better routines of greenhouse cultivation. Whether or not this could be reduced, if he were not otherwise employed, seems uncertain.

It may be mentioned that seedlings of deciduous species, all of which have normal flushes of growth and rest, unless kept growing vigorously from germination, are likely to stop by midsummer and show few signs of renewed growth before the following spring. Evergreen and semi-evergreen species are less likely to show this tendency and if they do pause in midsummer, usually break into many new shoots from the base in the autumn.

Once the seedlings are established in nursery beds, no further care is needed other than to keep them growing as one would any other kind of azalea plants.

To follow 62

Section on collecting seed

It sometimes occurs that a period of dry weather in midsummer or shortly after appears to hasten the maturity of azalea seed pods. In the senior author's experience this has been true, particularly for hand-pollinated seed pods that were only partly successful, i.e., that produced far less seed than would normally be produced. A further examination of pods from hand-pollinated flowers that did not reach normal size of development has shown that such pods in most cases do contain a few good seed. Such small pods may also ripen and open earlier than normal pods.

This means that the person who collects his own seed should begin to check the results earlier than the usual time that is expected for the region.

In this region a certain number of pods are damaged by insects. As yet the pest has not been caught, but the type of injury suggests that an egg is laid on the young pod and that the developing larva eats the entire contents of the capsule, leaving only chaff. The losses from this type of injury are not great enough to cause any special concern, unless there is but a single pod resulting from hand pollination.

Cuttings. Practically all evergreen and semi-evergreen azaleas can be rooted from cuttings quite easily. The deciduous species have been the subject of many experiments and it appears that eventually a way will be worked out for their propagation in this fashion. At the present time most commercial growers do not waste time on them and amateurs may well consider it as a technical pastime for the present.

A good cold frame is quite adequate for cutting propagation. The rooting medium should be at least six inches deep and no harm is done if it is deeper as this insures drainage. There are differences of opinion as to the preferred medium and each worker should use whatever he finds best suited to his conditions. The junior author, working in a greenhouse, uses pure sand, clean and somewhat coarse, with the cuttings placed in the sand bed on the bench and propagating cases over them. Here they can be watered as often as may be needed to prevent wilting of the leaves, should this occur. The senior author, who can care for his garden only in the evening and week-ends, prefers a mixture of sand and commercial peat, half and half, by bulk. The water-holding capacity of the peat is sufficient to keep the mixture uniformly moist. Experiments in the greenhouse, in which were used Vermiculite, fly (flue) ash, and mixtures of these materials with peat, gave satisfactory ^{returns} routines over the sand which usually is more cheaply and easily available in quantity. Review

annually ???

Review

The cold frame itself may be of any construction provided it is practically airtight when the sash are in place. If it is entirely above ground, it will require some winter protection if the cuttings remain in the frame after rooting and until after the completion of their subsequent spring growth. If it is below ground so that the natural heat of the soil assists in keeping down variations in winter temperature, less winter protection. This protection may be of any familiar sort, banking of leaves about the frame body, and a covering of mats or other shade for the top. Again, the aim is to reduce variation in winter temperatures. Just how much these practices must be modified in climates where winter temperatures do not bring freezing, the writers can not suggest from experience, but the aim should be the same, the reduction of winter temperature variations. Usually there is no need to open the frame during the winter months, but this again must be studied and determined locally, remembering only that one wishes to keep the cuttings dormant or with inactive tops until such time as top growth may normally be desirable.

The location of the cold frame is important. In the North, it probably should be in a sunny location because it is much easier to provide temporary shade than to see cuttings fail to root or root too slowly for lack of sun heat. In the North, it is the usual practice to let the frame sash slope to the south; in regions where summer temperatures are uniformly high, it might be wise to place the frame sloping to the north. This suggestion comes from the fact that summer temperatures in lean-to greenhouses facing north in our work have been appreciably lower than elsewhere, and certain types of cuttings appear to be more easily rooted if they do not have to endure maximum temperatures.

The cuttings themselves should always be taken from wood of the current season's growth, if quick rooting is desired. Older wood will root, but it is at a much slower rate and slows up the entire process of production with no special advantage, even if the resulting plant appears larger at the outset. The smaller plant from one year wood, if properly grown, will soon overtake and pass it and the vigorous young plant usually is much to be preferred.

From years of experience, the authors urge that cuttings be taken from the shoots that arise below the flower rather than from the vigorous shoots produced by the plant for building up its framework. These smaller shoots appear to have reached a certain equilibrium in growth as compared to the shoot that is still extending, that facilitates root formation, since, if they had been left on the parent plant, they would have continued the development of the terminal flower bud. They would urge also that the shoots be short rather than long. No tests have been made to demonstrate this, but in the production of the maximum number of cuttings from a single hybrid plant it was necessary to use many small twigs, even a few little more than one inch long. These root well if attention is regular and consistent and certainly better than 6 or 7 inch cuttings. The diameter of the twig seems to be of little significance, provided the shoot is in vigorous growth. Thin, somewhat undernourished shoots from weak-growing plants will root, but less uniformly and well.

There is no necessity for cutting the shoot from the parent plant at any particular point or in any particular fashion, except that the bark should not be torn. Roots are formed all along the stem and not particularly from the end. The leaves are removed from the portion of the cutting that is to be buried and enough more so that none of the remaining leaves touch the surface of the propagating bed. It is usually recommended that the leaves be cut from the shoot with a clean sharp knife or razor blade, but anyone can learn to strip them with a swift movement of the right hand, the cutting being firmly held in the left. The one thing to be avoided is the tearing of the bark, which is not likely to occur if the cutting is in the best condition.

This best condition is difficult to describe, but one can learn it quickly in a season devoted to trial and error. The old garden saying that the cutting should be in a condition where it does not snap like a match stem nor bend as if it were made of rubber, is quite sound. This does not mean that the brittle shoot will not root if given more time, nor that the rubbery shoot will not root if given careful shading with constant, somewhat high humidity, but rather that ^{for} quick, easy routine work, the intermediate stage facilitates operations. Whether in an amateur's garden or in commercial production, one is not primarily concerned with the problem of whether a bit of shoot can be induced to root, but rather with the problem of how swiftly can the unrooted twig be transformed into a rooted shoot ready to become a plant.

This same question lies behind the decision as to whether or not to use any of the root-inducing chemicals now available. They are not necessary for the rooting of the evergreen or semi-evergreen species and clones. We have not worked with deciduous species but understand that other workers have used them successfully under highly controlled conditions on deciduous species. Under somewhat limited tests, the appearance of roots on treated cuttings about 10-14 days before they showed on untreated cuttings is interesting, but when both types of cuttings were grown on, there was no appreciable difference in size of tops. It is conceivable, however, that with ample and adequate facilities, the treated cuttings, when rooted, could be moved from the frame to another intermediate frame before potting or placement in nursery beds. Since it is possible to keep a flow of rooted plants at a tempo that requires continuous space planning, without the use of root-inducing chemicals, the authors believe that their use should be left for the decision of each worker under his own conditions and procedures. The only word of caution is that the chemicals should be used at precisely the strength recommended by the producers to avoid injury of stem tissues.

The only other cautionary word at this time is the reminder that azaleas are hairy plants and that the surface hairs decay early but normally unless there is careless watering. Then decay follows and may extend to the leaf tissues causing the older leaves to drop and the smaller, almost scalelike leaves about the tip to hold too much water at their bases with decay attacking the growing tip of the shoot that dies progressively downward. This can be obviated by watering between the rows of cuttings and early in the day so that normal drying follows quickly.

REWRITE

to follow 72

It sometimes happens that cuttings, particularly of semi-deciduous varieties, tend to lose the lower leaves. These should be cleaned out to prevent their decay on the surface of the rooting medium, a purely sanitary precaution.

Cuttings should be inserted in the rooting medium so that a minimum of two inches of stem is in the medium. There is no particular advantage in much more although no harm comes from longer and more deeply inserted stems. The portions above the medium may vary, but if they can be uniform, the resulting plants will be more uniform in size and make a rather better looking product. In commercial work this will facilitate packing for shipment though it may have no or little significance for the amateur who merely wishes to increase his stock.

The cuttings should be placed in the row so that the leaves barely escape touching, but the rows should be at least four inches apart unless the grower means to move them as soon as rooting is established. The advantage of this wide spacing in the row will be apparent the following spring, if the cuttings are allowed to remain in place, for the young growths are often 4 to 6 inches long and crowd one another, with some losses of top if watering produces too great humidity.

The medium into which they are placed should be firmly but not heavily packed and well watered. The rows are made by marking the line with a knife or blade that opens a small furrow into which the cuttings are set vertically. The sand or sand mixture can be firmed into place with the fingers or watered into place with a very gentle spray.

Under most conditions, it seems best to handle cuttings quickly, not allowing great numbers to remain over night. The amateur who gathers cuttings from a large number of plants on his place may reduce walking back and forth by tying his cuttings together and dropping them, labeled, into a pail of water. When he returns to the frame or work bench, he should take all from the pail, shake off the water and lay them on newspaper and cover them with an equally damp paper, taking out each small bundle as he needs it. All work is done in a shady and airy place. The large operator needs no such instruction. If any cuttings can not be handled at once, a layer or two of newspaper laid over them, where they are spread out on the floor or cool bench, will keep them fresh over night.

Once the cuttings are placed, the frame is closed and shaded immediately, opening it again only to insert more cuttings, and closing and shading it immediately. This is not a problem when working in a greenhouse.

If propagating material is taken from plants growing out of doors, the time for the operation is determined by the condition of the shoots themselves. Usually this is a midsummer job. Under our conditions, cuttings may be taken in late June, more frequently through the months of July and August, but this may be continued much later into the autumn. If one must spread his operation, it seems advantageous to take cuttings first of the softer-leaved sorts, example, R. mucronatum (Azalea indica alba or ledifolia of some catalogues), leaving to the last R. indicum (azalea macrantha of catalogues) and its derivatives. The semi-evergreen sorts, such as R. Kaempferi and its derivatives should also be handled in the early part of the work, as they are quick to harden and after that root even more slowly than at best, a problem complicated by the easy dropping of the leaves.

If the stock plants are grown under glass, cuttings can be taken at any time they are ready, but it appears that in the somewhat more optimum conditions of greenhouse culture that cuttings come more slowly to this state than out of doors, particularly so if only plants are grown in benches. Experiments of growing stock plants in greenhouse benches in pure peat gave remarkable growth, both in heated houses with free standing benches and in pit greenhouses with little heat and the peat layer on top of the existing soil. These growths for many clones were somewhat slow to harden the foliage and made cuttings more difficult to handle on account of the easy wilting. When placed under fluorescent lights, they responded quickly and well. (See page).

to follow 79

In taking cuttings of the new shoots, one should avoid if possible any shoots in which the green color of the stem has commenced to turn brown, the normal bark color. Such cuttings are too hard to root quickly although they will root if left long enough under good conditions. This is something that must be watched for in cuttings taken from special forms of R. Kaempferi and many of its hybrid derivatives. It appears also in R. mucronatum and some of its derivatives. Since R. Kaempferi is rather more slow to root than many others, it should be taken first among the plants to be propagated. Since it is usually raised from seed, the difficulty is obviated unless one has a particular plant he wishes to increase, a specially good color form or one with larger or later flowers, and such variants do occur in seedling populations, often with flowers half again as large as normal blooms and in some cases flowering two weeks later than the main population.

110
Insert for somewhere in the discussion of cuttings

to follow 79

Whatever the medium used for rooting or the facilities available, the important factor to remember is that at no time the cutting should be allowed to wilt. This may happen without loss, but, if it can be avoided, it is much better.

When cuttings are taken from a bush growing out of doors, a simple and satisfactory practice, if there are any quantities, is to drop the cuttings into a pail of water and when the quantity is complete take them out, shake off the water and fold them in a single thickness of newspaper. Enough moisture will be absorbed from the leaves to keep the bundle moist. This can be laid in any shady place until the whole task is completed and then taken to the work area to be prepared for the propagation bench.

One may without loss or injury move cuttings about much more freely than would be imagined, provided it is done quickly and there is no drying out, either of the cutting itself or the incipient root mass. Success or failure usually hinges on manual dexterity and care to avoid shock after replanting.

Cuttings taken from plants being grown under glass to provide cutting material are frequently a little more slow to come to the proper condition for use, but plants grown under glass can and usually do provide cutting material over a longer period than do plants grown out of doors. This is sometimes very desirable when one is trying to obtain as many plants as possible from a single stock plant, within a limited time, a problem ~~not~~ that often confronts the hybridizer.

Once in the cutting bench, the moist atmosphere from the regularly watered rooting medium and the fact that the frame or case is kept closed, there should be little cause for wilting. When this does occur, it often is no more than an indication that the cutting was slightly immature and should not have been taken. A little extra shade may save it, since extra shade does reduce the maximum high temperatures. In general one is more likely to encounter difficulties of this type more frequently with the large soft-leaved types familiar in such species as *R. mucronatum* and its allies. If there is time, such cuttings are helped if the larger, older leaves on the prepared cutting are cut in half, the outer portion being cut away to reduce the area.

Occasionally one finds that cuttings are extremely slow to root. This is often the case if they are slightly hard, taken late in the season and grown cold. There is little that can be done to remedy this, unless a milder temperature is available. It is entirely feasible to lift the unrooted cuttings and transfer them to the warmer location, mild bottom heat (60-65° F.) if possible, without loss or injury.

As an experiment, the senior author attempted the late rooting of cuttings in an above-ground-level cold frame and in frames prepared on the floor of a cold pit house. The cuttings placed in the above ground level frame were made in mid-October and went into the winter looking well but largely unrooted. There were few survivors the following spring, save in those clones that had relatively small hard leaves. The frame in the pit house, covered with a cold frame sash as additional protection, was filled the first week in November with a wide range of types. Rooting was about 95% completely, but a few clones of the semi-evergreen types failed almost completely when shoot growth commenced in spring. An examination of the dead cuttings showed very small root masses. The uncovered frame in the pit was filled the week of November 15. These appeared to come through the winter well, but there was almost complete failure among the soft-leaved forms when shoot growth began. Although these results are from one season only and a relatively mild winter, they follow a pattern of failure observed under other conditions. The only shade given during the rooting period came from a single layer of burlap sacking. This was increased during the actual winter months to lessen the temperature changes between day and night and maintain a more constant temperature that would not encourage any impulse toward growth.

a further ?
As an experiment, the senior author in 1948 made three lots of cuttings after the preferred time, using only his home equipment. In October, a two-sash wooden frame, all above ground level was filled with cuttings of a wide variety of seedling clones. These went into the winter with every appearance of satisfactory condition, although examination showed that some had not rooted at all and that most of those rooted had rather small root masses. The winter following was milder than usual but the sash was ? were covered with a heavy layer of burlap; the sash was not banked with leaves or any other protection. In the spring (1949) most of the cuttings looked well enough, but soon collapsed, even those that had small root masses.

From observation over a considerable number of years, it is possible to suggest that any clone with flowers having a white or light-colored ground, marked by stripes or their variants, almost may be depended upon to produce sports. The most common type is the self-colored flower matching the color of the stripe. It is all right for the amateur to keep this in his garden for novelty's sake, but the propagator should cut it out at flowering time to avoid taking cuttings from such a branch and so perpetuating a self-colored race that does not sport back. Slightly less common are the sports that show an irregular white margin. These, too, must be labeled and avoided or else cut out. Less often, and only in certain pedigrees, the sport will take the pattern of a white flower with a colored margin. These again must be avoided in propagation of the named original striped clone. All of this means extra work for the nurseryman unless he maintains a permanent collection of plants from which he takes all his cuttings, instead of following the rather common practice of taking cuttings from anything large enough to be cut to pieces.

The first week in November, a propagating bed was made on the floor of the pit greenhouse that could be covered with a sash. A similar but not identical collection of cuttings was used and there were no failures except with one or two clones containing Kaempferi blood.

The second week in November, a similar bed was made on the floor and filled with a comparable lot of cuttings. This bed was not given the extra sash cover. Rooting was excellent in this bed except for those clones that had R. mucronatum blood. These survived the winter apparently in good condition, but less than 10 per cent rooted, mostly as small root masses in December, growing quickly into better masses in the spring. Since R. mucronatum and its derivatives should be rooted early, this was an extreme test, but is useful as an indication of the possible use of home facilities. Derivatives of R. indicum rooted as well as any taken at the preferred times. The rooting medium in all cases was sand and peat, half and half by bulk. No root-stimulating substances were used and the cuttings were good material, in good condition.

Since the flower bud is usually well formed as the time the cuttings are taken, many will flower in the cutting beds the following spring. This is often useful as it permits the removal of any rogues if they have occurred and the correction of any mixtured, should accidents happen.

If the cuttings are well rooted and are properly cared for, the flowering appears to have little effect on the young plant. If there is any doubt on these points, the flowers should be snipped out with shears so that all vigor can go into the shoot growth.

Frequently pollen can be taken from them and put into storage for similar odd combinations. This has been true chiefly for late-flowering clones grown in the cool greenhouse that had lost their seasonal rhythms.

In a few cases, these tiny plants have been used in making crosses and have produced normal pods, as well as good shoot growth. As their flowering is frequently a little out of season, one may sometimes be able to make a combination otherwise impossible, even with stored pollen.

insert - cuttings section

Aside from selecting the correct type of cutting material in the proper condition, a word of caution should be said that cuttings should be free of insects and disease. The latter is not often present, but torn leaves should be cut off before the leaf is put into the case or frame. Sometimes, however, it is necessary to use cuttings from plants that have been infested with lacewing fly or leaf roller. The former is easily killed out with any of the modern DDT sprays applied a week before the cuttings are made. The latter, whether present in the leaf-rolling stage or while the larva is still mining its way through the leaf tissue (nearer the under surface of the leaf), can be controlled here by picking off all such leaves when the cuttings are being prepared for the propagation bed. In this region the latter is a minor pest out of doors but flourishes in the greenhouse, where one of the modern bomb-type fumigants must be used. (Ask Creech name of the poison gas he used at Glenn Dale). has proven satisfactory in greenhouse work used with all the necessary precautions. Red spider, if present, is usually reduced to extermination by the relatively high humidity of atmosphere in the rooting frames or cases. If it persists, will check its attack if it does not eliminate it entirely.

Cutting section

The only types of azaleas for which one must take more than usual precautions are those clones described as having striped flowers. To these must be added those clones that have a marginal pattern of color on a white base.

It would appear that for survival, there must be a rooting period of at least two months during which day temperatures must be high, the actual range being relatively unimportant but subject to ^{modification} control and the night temperatures high enough so that there will be no delaying action from the alteration. Since no temperatures were taken, the trial reported is inconclusive, but as a matter of mere guidance one may venture the hypothesis that night temperatures should not fall below 60° F., which is the average low for our area. This conjecture obviously must be modified in interpretations for other regions, whether south or north. The only value lies in the implication that the southern nurseryman or amateur probably has a longer period of operation than any other and that if he is limited it will come through an earlier maturity of the new growths, something that he can delay by cultural practice if he will, either by extra shade or by a pruning that will check normal growth and produce a delayed crop of new shoots.

Watering of frames or cases filled with cuttings in process of rooting should be done in the morning, so that any moisture on the leaves will dry before night when temperatures drop. This is standard practice for most propagation work. If one's work day makes it impossible, no serious damage results if one is careful not to soak the close packed leaves of the growing tips, particularly in clones or varieties that are very hairy. Each worker must experiment until he finds the routine that suits his own work schedule.

The amateur who purchases plants of a supposedly striped variety and gets any of these variants should understand, however, that they represent accidents in propagation and no intent to sell stock that is not true to name.

The care of the rooted cuttings presents few problems. In the greenhouse with its artificial climate, they may be lifted from the cutting bed and planted in benches or be potted. If they are put in beds, the soil may vary in character according to the aim of the grower. Should they be intended for the production of new plants to be cut to pieces for more cuttings as quickly as possible, the soil may be pure peat. Our experience shows that enormous root masses are produced and excellent shoots. These tend to be long and unbranched so that it is wise to remove the growing tip and force branches that will provide desirable cutting material. If the plants are to be sold, either the soil should be a peat-soil mixture or the prospective purchaser must be warned that the plant should be planted in a soil with slightly greater admixtures of peat than he would usually consider, after having shaken off part of the pure peat from the root system. In ordinary gardens, the bed may or may not have been prepared with a soil mixture that permits movement of soil moisture and maintenance of a uniform degree of moisture. If the root mass in the pure peat is planted in such a bed, water may move too easily into the peat, killing the plant by excess of wetness, or it may fail to enter the peat mass, so that the latter dries out and the plant dies. If the rooted cuttings are to be potted, the operator shakes off a portion of the sand adhering to the root mass and uses a potting mixture in which there is little more sand than he would use for older established plants. Here again is the same basic problem, a soil mixture devised to aid the transition. The pots should be placed in a sheltered position for several weeks and then transferred to an open bench, where they are sunk to the rim in more peat.

The amateur or commercial man using cold frames alone will find that the easiest method is to wait in the spring until the first shoot growth has been completed and matured and then move his little plants into nursery beds. If he has room, they will benefit by planting in beds that can be covered during the next winter with some sort of protection that will modify marked alternations of temperature. Whether this will consist of a mulch of leaves, brush, lath frames, or sash depends upon the exigencies of the winter climate and his willingness to grow good plants. If there is time, the tip of every shoot on the rooted cutting should be cut off about a week before the transplant. This and the actual transplanting will check top growth, stimulate root growth and then cause the formation of a new set of branches that rarely occur spontaneously or, if they do form, form late in summer and frequently do not mature before cold winter weather, with subsequent loss.

The chief trouble for many persons, after this period, comes from losses the first winter after the rooted cuttings are set out in beds. It usually appears in the form of bark splitting that may be so complete as to girdle the plant and kill the top. Regeneration may occur from the base or the entire plant may die, especially if the root system is poor. The problem here appears to be a mechanical difficulty. As already remarked, the bark on azaleas is a thin layer and easily damaged. If the abrasions are light and the injuries come during growing weather, ~~the~~ healing is usually normal. During cold weather there is almost no chance of healing and if the bark splitting is severe, even less. The same sort of winter injury is sometimes found on old established plants. The general opinion is that the injury is really a rupture of the bark tissues by the expansion of the frozen sap in the tissues immediately under the bark and the suggested treatment, entirely preventive and not always possible, is that cultural practices should be such that growth is discouraged from about one month before the first killing frost is normally expected. If the plants are growing in the open and there is continuous rain in early autumn, there is little that can be done. If the plants are dependent upon artificial watering, this can be first reduced and then stopped. The senior author uses beds raised about 4 to 6 inches above grade for his seedling nursery and can report that these do dry out a little more quickly than plantings on grade, but that there were losses in about equal degree.

It is the opinion of the authors that this type of loss is not a safe index of hardiness, since they have had such losses in cuttings taken from old plants that had been out of doors for many years.

It is mentioned chiefly because there are many amateur collectors of azaleas, who "save money" by purchasing small-sized plants. Unless such plants can be given protection for the first winter, the savings are often lost.

Although it is included almost parenthetically, the deep frame or the cold pit is a very useful affair for the amateur azalea grower. In this climate, the deep frame is made exactly like a cold frame except that its floor is well below frost line, in our climate ? 4 ? feet below grade. Plants of borderline hardiness, or weak cuttings in such frames over winter well. The cold pit house is built on the same principle and has chiefly the advantage that one may walk into it. The senior author's pit is only feet below grade and would be better if it were feet. No freezing ever occurs at floor level, but on the bench at the usual work level, freezing does occur at zero temperatures outside.

Training the developing plants presents little difficulty. To hasten branch formation, one need only cut off the growing tip of the shoot. If only the extreme tip is cut off, it usually happens that it is replaced by a single shoot developing from the axil of the uppermost leaf; if the cut is made lower where the wood is already somewhat firm, shoots will come from the uppermost three or four leaf axils. These in turn can be stopped as one wishes and a bushy plant will quickly develop. Carried to its extreme, it has produced the umbrella-shaped heads familiar in the florist's azalea, or in the Japanese garden, the picturesquely branched plant that simulates old age. The aim in either case is the same, to arrest free growth and hasten the formation of the short twigs that flower freely. Some species and clones respond more quickly than others, chiefly those that normally produce short shoots, for example, some of the Kurume varieties and nearly all of the "macrantha" forms and derivatives. It is a type of training that can be applied only to more free-growing shoots that normally would make the skeleton of the shrub, or, if loss of flowering for a season will not matter, to all growing shoots.

If one is beginning to make an azalea planting, he will want to know at what time he should purchase his plants and in what sizes. The answer in each case is simple, but in each case the ^{practice} ~~purchase~~ is open to manipulation.

The plants should arrive in the garden when they are dormant. For all deciduous species this means either early spring or late autumn. The advantage of spring planting over any other is that the plant will have ^a long growing season in which to establish its roots in the new site. In regions with cold winters ^{late summer + autumn planting do not use as} the roots usually will have little if any time to push into the new soil and the following spring may be slow to do so. If they are slow, whatever growth the plant may make will depend upon whatever plant foods may be in the plant itself and these, not being normally replenished may produce a somewhat stunted growth from which the plant may recover slowly. The plant progress will in each case depend upon the care given. The semi-evergreen and evergreen species can be ordered for delivery at the same times, but in addition may be ordered for delivery in late summer, just as one would for conifers. It has been the experience of the senior author that plants of this type from nurseries south of his location establish themselves more quickly if received in July or August than if received in the spring, since even March delivery will bring them to him with soft shoot growth that is practically lost, no matter how much attention was given to watering, spraying of foliage and temporary shade. Plants received in late summer showed no check and were well established with new root growth before the advent of cool weather.

Most azaleas are shipped with soil on the roots and the root mass wrapped in burlap. There is a tendency to plant any such plant with the burlap in place since it decays easily and quickly when buried. Unless the "ball" has actually been broken in transit, the senior author prefers to remove the burlap and to shake off at least a third of the soil received before the plant is set in place, filling the hole with a soil mixture that will consist of the soil shaken off mixed in equal bulk with peat. There is evidence that this assists the plant in making the transition from one soil type to another. For him, this is more important with plants from the South that have been grown in sandy soils than those from clay soils since his own garden has the heavier type of soil.

If plants are received "bare root" as may be necessary if they come from certain quarantined areas, it is desirable to plant them temporarily in a soil in which there is more peat than would be normally given in order to hasten the formation of new root masses. The second transplanting can be made at whatever time would be desirable. If the species is deciduous, the tops may be cut off drastically, leaving perhaps no more than 4 to 6 inch stubs. These will break into good new growth in about three weeks. This practice is very useful if one collects color forms of native azaleas in the wild. The only loss will be one season of blossoming while the plant is making a new top.

In general, the maintenance care of azaleas is relatively simple. Feeding has already been discussed. (Page). The question of pruning has been touched upon in the discussion of the training of young plant. There seems to be differences of opinion as to the desirability of pruning of old plants. The experience of the authors has been chiefly with semi-evergreen and evergreen azaleas and they have found that both under glass and in the open azaleas show no damage from pruning, no matter how severe. The only thing that must be borne in mind is that, after pruning, the bush first produces the type of shoot that makes the plant framework and not the short flowering twig. The latter will appear only have repeated light prunings.

The question of pruning as most often raised by the amateurs in our experience has been as to the advisability of cutting off the long unbranched shoots typically produced by such species as Kaempferi or such clones as the Kurume variety, Minomayo. Our experience with Kaempferi and many of its derivatives, such as the Koster hybrids between Kaempferi and "malvatica", has been that the plant immediately produces one or more shoots that give the same sort of growth and our opinion is that the natural leader should be allowed to make its full height, with widely spaced whorls of lateral branches. In time these will fill in and make a full bush of very fine and characteristic branching. This is more quickly true of such clones as Minomayo and the poorer appearance during the early years should be tolerated for the sake of the eventual height, often not to be had from species or clones that become dense and twiggy early in their development. If one will study a collection of mature plants that have been allowed to take their natural forms, he will discover a wide diversity of plant shapes and styles, from the low, dense, almost creeping forms of some "macrantha" clones to the tall plants that show broad-spreading, almost shelflike branches, reminding one of flowering dogwood in sweep and picturesqueness. All these are at his disposal if his plantings are to be "naturalistic", pruning and the use of naturally compact forms are his choice if he wishes a more stylized or formal treatment.

to follow 94

Once the developing plant has reached the stage where it is producing flower buds, no further pruning of this type is needed unless the plant throws up strong shoots from the base. These can be topped at any desired level to induce the formation of lateral branches.

As all of this involves a period of continuous growth, water must be supplied regularly in order to stimulate even development.

For older plants, the same principles apply but as one is more concerned with a normal production of lateral shoots that bear flower buds, he can determine the frequency of watering by the normal growth. The critical period for observation should begin about August 1 by which time flower bud formation is under way. The deciduous species show flower bud formation much earlier and more clearly than do evergreen or semi-evergreen sorts. Of the latter, R. indicum forms conspicuous flower buds later than any other observed here, although doubtless the initial stages are well under way before the bud is large enough to be conspicuous.

After a bush is stripped of material for making cuttings, some attention should be given to watering in order to assist the formation of new shoots. If the cutting wood is taken early and some care is given, the plant will often refurnish itself with enough new shoots to flower well. The only guide for this is furnished by experience.

Watering during the period of flower bud formation should supplement rainfall.

For the person who wants to harvest seed, whether hand-pollinated or chance, a watering program is advisable in order to keep the seed pods developing without check. As mentioned before, seed pods come to almost their full size within a month after the flowers fall. The senior author feels certain that some of his controlled crosses gave little seed, because the plants growing in a somewhat dry and exposed position were not watered during such a period. Capsules formed but they were smaller than normal and the seed content was less than was expected.

It has been suggested that azaleas should not be thought of for use as "cut flowers". This, of course, is nonsense, provided only that branches are cut in such a fashion that the shape and character of the bush is not damaged. It has been the regular practice of the authors to cut branches from free-growing older plants and in most cases no one could tell where they had been cut without careful inspection. Obviously, one could find little to cut from the almost boxlike growth of the trained florist's azalea, but even those plants, if allowed a little latitude, will show a looser growth that will provide some material for cutting. Since they are not hardy to cold and since most of us must grow them in pots, there is no need for cutting for the entire plant may be had for decoration.

If potted azaleas are used in home decoration, it should be remembered that they will suffer immediately from hot, dry air and from drying out of the root mass. If one buys a blossoming azalea as one buys cut flowers with no thought for its preservation, ordinary watering, an occasional syringing of the top and as cool a position in the house as may be provided, are all the necessary attentions. If one wishes to preserve it, he should look first at the soil in which it is growing. If this has dried out before he buys it, as often happens in the transfer of the plant from grower to retailer, he should immerse the whole pot in water until no more air bubbles rise, usually a matter of one to two hours. Then the plant pot should be stood where all free water can drain away. After this, the plant can be set in its decorative position. It should not be stood in a saucer of water. The owner should learn to tell by feeling the soil with his fingers the moist condition of the soil that is like that of the plant growing outside and water only as needed. A good watering, following by careful draining is always wise.

If the variety is hardy to cold, it can be taken from the pot and planted out of doors when the weather is warm, not earlier. Annually, hundreds of forced Kurume azaleas go to their deaths because they are planted out as forced plants in full flower, often as much as a month before they would bloom normally in the region.

If the plant is a tender variety, one should examine the soil and if this appears of poor quality, it should be replaced by a proper soil. Many azaleas come to market in soils that appear too full of clay for best growth. The flowers should be cut off as they fade, and the plant stimulated to make a good crop of short new growths. ^{of a summer} The pot should be plunged in peat, out of doors in a place where ^{it} ~~it~~ will have good growing conditions as for any other azalea, any site being possible except sites in full sun or in complete shade.

The race of florist's azaleas now extant appears to have been bred for a variety of characteristics, most of them common to all azaleas. The one characteristic that distinguishes them, perhaps, is a capacity for coming into full bloom at other times than the "normal" season. Put in other words, these are plants that can grow and function with a shorter than normal period of "winter" rest. This capacity is by no means equal in all varieties, as one may deduce by looking at commercial lists or horticultural records, where one will find that only a small portion of catalogued varieties are listed as useful "for Christmas forcing". It is true that with our expanding knowledge of what does and does not happen in a rest period, whether associated with cold or not, we have come to a somewhat more complete understanding of the growth processes, and so can devise practices that appear to hasten the manifestations of the life cycle, but the use of these processes creates oftentimes other problems for which other adjustments must be made. If one of the tender azaleas of the florist's group is not grown under the routine that facilitates precocious flowering, it often shows a tendency to flower intermittently.

This tendency to irregular blossoming rarely concerns the gardener who grows his plants out of doors, except in regions of mild winters or, in some cases, under actual conditions that tend to wipe out the full effect of the rest periods. In the deep South, one will find recurring bloom on the florist's azaleas through the summer and precocious flowering on some of the Glenn Dale azaleas. This latter has been reported from the Bay Region in California as well. Whether or not this tendency can be extended, either by breeding to make it inherent, or by cultural practice, is as yet problematical. It is mentioned in this bulletin only to forestall questions about its management. At present there is no answer for outdoor work, except to offer the opinion that some form of R. Simsii seems to be responsible for the quick response in flowering upon slight rises in temperature. At some later time, the accumulating evidence may warrant a more explicit statement.

or

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indicum
 but derivatives
R. indicum are more common
 to occasional out-of-season bloom

This reference to florist's azaleas as forcing plants also permits a parenthetical discussion of grafting as a means of increase. In this field the authors have no experience and must report only that among azaleas grafting was and to some extent still is the only commercially swift and certain means of propagation of certain clones.

Until a fool-proof method of vegetative increase is found for the deciduous clones of the Ghent azaleas and their allies in the same section, or until American nurserymen can be persuaded to adopt the somewhat slower but perfectly assured method of mound layering, it is probable that all such azaleas will be winter grafted upon seedling stocks of the same blood.

The European use of R. luteum seedling stocks is regrettable as this species is not happy or vigorous in regions where there are long hot summers.

The only argument against mound layering is the initial time lag.

The process is simple. One chooses a site favorable to azalea growth and preferably distinguished by a constant and relatively high water table so that the annual production of wood is uniform. There should be three sets of parent plants and these are encouraged to produce as many stems from the base as is possible. For this reason they should be on their own roots. The increase of shoots is brought about by cutting off the existing top about 2 to 3 inches above ground level, in early spring. Dormant buds will push into growth from each stub. When these have matured, as indicated by the appearance of normal bark coloring, grayish or brown as opposed to green, they are buried in a mass of good azalea soil (the usual sand-humus mixture), leaving only the tops exposed. The mound must not dry out excessively and if the site is reasonably moist, will not. By the end of the next summer the shoots produced the preceding year will have made new tops and a larger or smaller mass of roots. This can be determined by loosening the soil of the mound and examining the roots. If they are adequate, the mound is torn down gently the following spring and all the rooted shoots cut off, leaving again 2-3 inch stubs. These, exposed at normal soil level, once more produce a crop of shoots, but greater in number than before, certainly double, often more. With three sets of mother plants, put into production successively, there is a constant production of small one-year, own-root plants that can be given routine nursery treatment for growing on.

The other group of azaleas that are commonly grafted are the tender florist's azaleas. The traditional stock is R. phoeniceum or its clone, concinna, both of which are easily rooted from cuttings and grow vigorously. It has recently been reported that the stock used is R. mucronatum which roots and grows as readily but seems a curious stock since, being relatively cold hardy and with definite southern limits out of doors, is more seasonal in its growing habits than the less cold hardy forms of R. phoeniceum.

The cuttings are grown to pencil size, given a type of graft and kept in a cool greenhouse, planted in the beds or in pots sunk in peat. As soon as the graft shows signs of activity, the top of the stock is first topped and later cut off clean at the union. The scion itself is variously topped until the well-branched head is formed, familiar in the conventional umbrella shape. Judging from old literature, one deduces that the practice came into being for the propagation of bud sports. It is often referred to as applied to weak-growing varieties, which may or may not be the entire story.

In old books of cultural directions, the advice is frequently given to "cut out strong growths." Since these books were presumably addressed to the grower of exhibition plants of the conventional umbrella type, the advice is understandable, but one wonders if the nurseryman did not have "at home" some free-growing plant on which these strong growths had been allowed their normal development and that might not have produced an abundance of wood for cuttings. The practical argument against such a practice may have been the fact that bud sports are not entirely stable as they first appear and, unless one has marked for non-propagation or has cut out at flowering time all reversions, varietal propagation is not safe by cuttings.

The problem may first have arisen in the propagation of striped flowers. As far as our own experience goes, it seems safe to suggest that branches may regularly be produced that give self-colored flowers of the same hue as the stripe. In our own experience, but to a lesser degree, propagations from these self-colored shoots never produce striped flowers.

Plants with striped flowers may produce two other types of sports, one in which there is an irregular border of white on a colored flower that usually shows a good blotch of color on the upper lobe and may or may not show some striping. The other, and in our experience less common sport, is the white flower with an almost even margin of color. Plants of the first type raised from cuttings continue to produce occasional shoots with self-colored flowers; plants of the second type, grown on from cuttings, show some variation in the size of the white center. There is some evidence that cuttings taken from vigorously growing shoots on these plants do not give typical flowers on first blooming, but cuttings, smaller and weaker from the slower, more mature flowering wood, carry on the original pattern. Each of these "sport" patterns have finally appeared in seedling plants, but these are too few and too young to serve as the basis of any pronouncements.

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Plants grown from vigorous shoots and not flowering normally the first season, later produce normal flower patterns from the shorter tops.

The importance of all this is ^oabvious to the commercial propagator. To the amateur it is important because he should know that if he has ordered a plant with striped flowers and its blossoms prove to be of solid color, the plant represents either an accident or carelessness in propagation.

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There is regularly offered in trade "Purple Vittata", which is merely the clonal propagation of those shoots producing self-colored flowers from the original striped clone. The senior author has in his garden self-red-colored plants of Iveryana, a white variety with occasional red stripes. From the beautiful late-flowering Japanese variety, Mai-Hime, introduced by the Department in 19 and sent to the trade in , characterized by the introducer as rose pink with a darker blotch of rose red on the upper lobe. The senior author has separated by cuttings three shoots, one rose pink without blotch, one with an irregular white margin and occasional stripings, and one a milky white with a few pale stripes and a slight blotch. These have been further propagated by cuttings but not enough time has elapsed to know what may appear as reversions. From past experience, it is surmised that they will appear only on the last named sport, a conjecture based in part upon the familiar occurrence of branches with pinkish-lavender flowers upon such varieties as R. micronatum or George Lindley Taber

The authors have no personal experience to suggest the age to which azaleas may live, nor at what time it would be reasonable to expect symptoms of old age and decline. There are plants of our native deciduous species growing in the wild that suggest great age if one may judge by the size of the woody stems at ground level. There are also in some of the oldest southern gardens plants of azaleas imported into this country, according to family records, in 18 , a matter of some years. They are apparently in vigorous health.

Since the plants react vigorously to accident or injury to the tops, as for example fire in nature or storm breakage in gardens, they appear to be long-lived. Even plants that have suffered poor growing conditions for a year or two, short of complete dessication, will slowly restore themselves with vigorous new shoots from near the base rather than from an invigoration of the parts of the plant that suffered the temporary calamity.

The hazards in azalea culture are of two sorts, those that arise from lack of understanding the cultural limitations and practices and those that come from natural causes. The former have already been discussed; the latter follow.

If one were to make a complete catalogue of all insects or diseases that have ever been collected from an azalea plant, the result would be distressing and discouraging.

In the senior author's garden experience, no insect has been of major importance. In this area the most common is the lacewing fly (Chrysopa californica) an insect that works on the under side of the leaves, sucking ^{out} the chlorophyll and leaving the foliage with a gray to silver appearance. Its attacks are most severe on plants growing in full sun, but it is not limited to such plants. It must be controlled by a contact spray. The stand old method was the use of nicotine sulfate sprays at intervals of about a week over a period of 4 to 6 weeks to insure the destruction of all insects, as these do not appear in uniform hatches. The modern sprays, derived from the original DDT, are more potent, some such as _____ being reported as destructive, even to the eggs. These sprays, however, do not affect red spider which thrives under conditions similar to those preferred by the lacewing fly. For the latter, sprays of _____ are recommended.

The next most common insect is the white fly, a pest that becomes increasingly abundant as one travels south. Its preferences seem to be R. mucronatum (azalea "indica alba", A. ledifolia of trade) and its derivatives, all of which have abundant glandular hairs.

(Ask Freeman about its feeding habits)

It is usually controlled by sprays of

As far as the senior author's experience goes, it is annoying to see but has no particularly damaging effect on the general health of the plant. His plants of R. scabrum overwintered in the cold pit have been more seriously attacked and have subsequently developed attacks of the sooty mould fungus that first disfigures and later smothers the leaves. If this fungus occurs, it is controlled by spraying with

In the open, there are various insects that make minor inroads, none serious to the health of the plant. A leaf roller, _____, makes its larval nest on the under side of the young leaf, eating the tissue as it pulls down the leaf tip or side to cover it during the pupating stage. This, as yet, has not become common enough to warrant special attention.

There is also an insect, as yet uncaught, that eats the youngest leaves at the tip of the growing shoot but rarely injures the tip itself.