UNITED STATES DEPARTMENT OF AGRICULTURE
CIRCULAR No. 102

Washington, D. C. February, 1930

THE PRODUCTION OF LILY BULBS

By

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FOREWORD

The production of lily bulbs in America is a comparatively new venture, although the garden culture of lilies is an old one. The industry has received a decided impetus in the last few years, due in the largest measure to the discovery that the production of the stocks presents no unusual difficulties; indeed, most of the species may be easily grown in the regions of the country adapted to their development.

The information that has contributed most to the interest in the venture relates to the successful reproduction of the vast majority from seed, effective propagation from scales, and a large application of propagation by bulbils and stem bulblets. Few groups of plants present such diversity of reproductive adaptation.

It is significant that already several lilies have become characteristically American. *Lilium regale* is so widely known that no importations are made. *L. willmottiae*, *L. bulbiferum*, *L. sargentiae*, and *L. tenuifolium* are produced not only in commercial quantities but in quantities sufficiently large so that dependence is placed on the domestic supply. *L. candidum* and *L. excelsum* are being worked up to a similar production and should be produced in sufficient quantity for our needs. Why *L. tigrinum* should continue to be imported is an enigma not easily explained, for it yields to no plant in its readiness of reproduction and ease of culture. Furthermore,

the form so commonly cultivated in our gardens, especially in the eastern United States, is a better lily than the one regularly imported from the Orient.

There is a good business in all species of true lilies, but the large consumption is and probably always will be in those that are used in forcing. The market supply of the others can more easily be overdone. The largest consumption by far to-day is of the various forms of *Lilium longiflorum*. *L. regale* is forced more and more. The speciosums and auratums are largely forced also. *L. candidum* used to be the Easter lily, and *L. excelsum* is just as easily but very seldom used for forcing. It is yet altogether too high priced for that.

The *Lilium umbellatum-elegans-thunbergianum* aggregation may become of more importance than now appears, for they are easily forced and make good pot plants. Quantities of them are so employed in Europe, and they have made an appeal on one or two markets in this country.

The word "lily" is a part of every man's vocabulary, although he may often misapply the name. Generally it is altogether too inclusive and often applied not only to the wrong plants but to very remotely related ones. There are waterlilies, pond lilies, daylilies, plantainlilies, spiderlilies, Lent lilies, lilies-of-the-valley, and many others. This circular considers none of these, but deals with species and their derivatives of the botanical genus Lilium. These are the true lilies, to which the word is applied unmodified.

Were one to ask a botanist for a definition of the genus Lilium, he would say among other things that its members all bear their seed vessels (ovaries) above and free from the floral envelope; that their flowers are funnelform or bell-shaped; that their six floral segments are colored and are nearly alike; that these segments bear a nectar furrow near their bases; that a stamen is inserted opposite each segment and more or less attached to its base; and that the large flat seeds are densely packed in two rows in each of the cells of the 3-compartment ovary. These characteristics distinguish the lilies from other groups of plants.

The genus has a very extensive literature, but much of it is not available to the average man. It is only in the great libraries that it can be consulted. There are a few books, however, that are within the reach of all, and every lily grower should have several of them.

The recent renewed interest in lilies has brought the literature decidedly up to date. In 1925 Wilson (*10*) [1] published the results of his long research into the most important lily region of the world. Marshall (*8*) has published recently an annotated, illustrated list in book form. Craig (*2*) treats of the lily in America, while Fox (*4*) discusses it as the Cinderella of the garden. In 1913 Adams (*1*) published a book which is one of the most useful and is still obtainable. The English garden aspect of the subject has been well presented in book form by Goldring (*5*), Grove (*6*), and Jekyll (*7*). One of the most useful books for the student of lilies is by Wallace (*9*). In a few special libraries copies of a large folio volume by Elwes (*3*), illustrated in color, may be consulted.

[1] Italic numbers in parentheses refer to "Literature cited," p. 56.

Much of the most valuable literature of the genus is scattered in trade and professional journals and gardening periodicals, back numbers of which are available only to those having access to large libraries; but current numbers, now that the subject is popular, contain valuable up-to-date material. Another most important and valuable source of information on lilies is the catalogues of seed houses, bulb firms, and nurserymen. This source is rapidly becoming

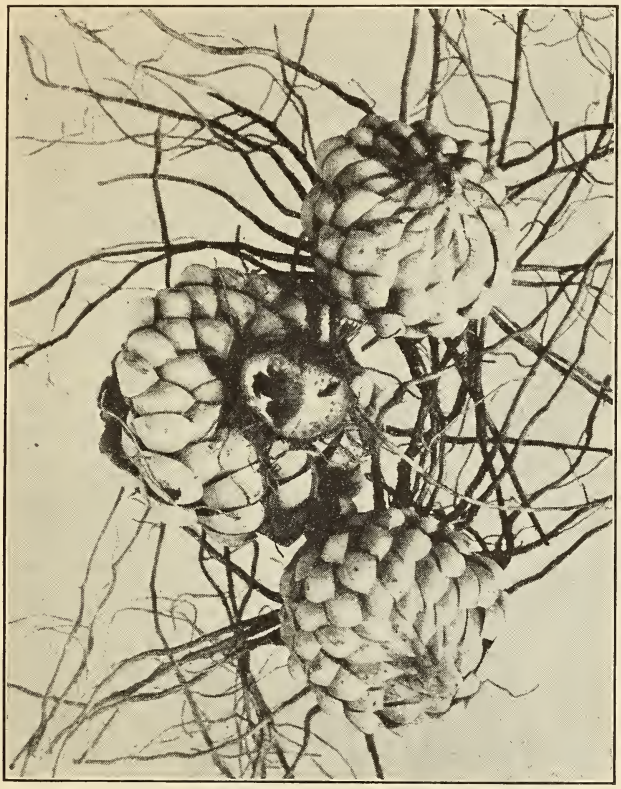

FIGURE 1.—Underground parts of *Lilium superbum*, showing one current year's bulb and two to flower the next year. Northern Maryland

of greater importance and reliability. Some of these firms issue books of directions for growing lilies and other bulbs.

THE LILY BULB

The lily bulb consists essentially of two obviously distinct parts; one a basal structure which in many cases is plainly a rhizome (fig. 1) and in others less plainly so (fig. 2). From this basal structure arise alternate layers of scales superimposed and overlapping each other, forming the other part, which is the bulk of the bulb. The true roots arise from the under surface of the basal structure. These, except in dormancy, are large, often contractile in structure, copious, and prominent in numbers.

When the bulbs are dug the base of the stem which has recently flowered is prominent and is flanked on one side with large, rather loose scales in *Lilium candidum*. On the opposite side of the stem is the larger, more solid portion of the bulb, containing progressively smaller and more delicate scales as the center or growing point is approached. It is from this point that the following year's stem develops. In *L. superbum* (fig. 1) the next year's stem proceeds from a very comparable structure, but it is separated by an underground rhizome from that of the current year.

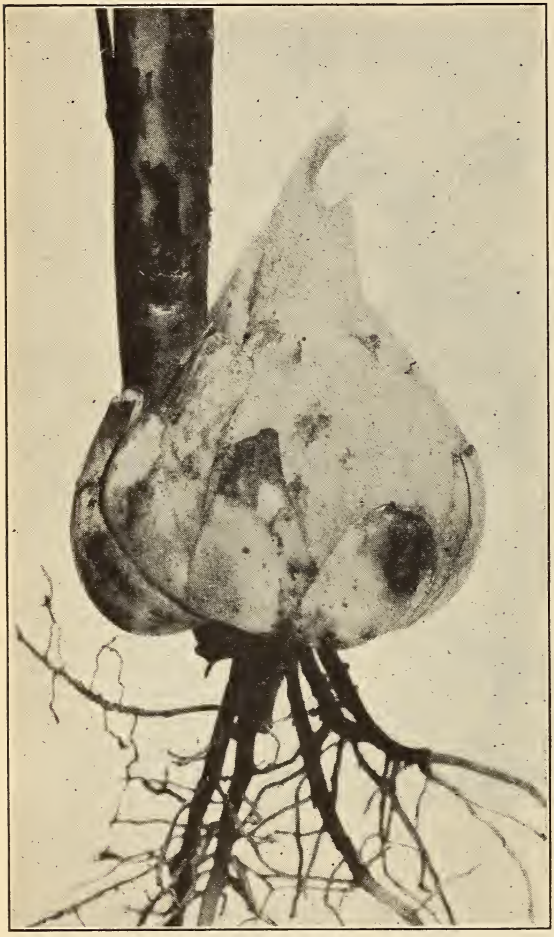

FIGURE 2.—A mature bulb of *Lilium candidum* as dug in July with base of stem attached. Bellingham Bulb Station, Bellingham, Wash.

In the case of bulbs that have not reached maturity, the whole structure consists of the growing point and surrounding scales from the center of which continuously appear new leaves, the dilated bases of which form the successive imbricated scales, until the bulb gets large enough to throw a stem.

The space between the old stem and the crown is very variable in different species of lilies. In *Lilium candidum*, as illustrated, it is short, so that the whole is included in one solid bulb; but in some lilies, like *L. superbum* (fig. 1), *L. pardalinum* (fig. 3), *L. parryi*, and others, the space is lengthened into a stock of appreciable dimensions, so that the portions which produce stems two successive years are really separate bulbs. These features are well illustrated in Figures 1 to 3.

WHERE TO GROW LILIES

One must keep constantly in mind that, while lilies may be grown for decorative purposes over a very wide range of conditions and many of them seem to be very adaptable under commercial

production, there are certain climatic and soil characteristics that make for economy of production and handling. These conditions mainly are relatively low, equable temperatures, a relatively high atmospheric humidity, abundant and well-distributed rainfall, and a porous soil high in organic débris. The region that can furnish the greatest number of these conditions in the greatest perfection is the best for lily-bulb production. Fortunately, however, these conditions do not have to be met in their entirety for commercial

FIGURE 3.—Bulbs of *Lilium pardalinum* grown in two years from a double-nosed clump. Seven stems were produced the current year and 15 or more are outlined for the next. Bellingham Bulb Station

success, and many lilies may be made to succeed admirably when one or more of them are imperfectly met.

Doubtless no region will ever be found where all lilies can be produced commercially, but it has been found that a very large number of them grow well under field conditions in the Pacific Northwest, in the mountains of Tennessee and the Carolinas, upon the Atlantic Coastal plain, and a few on the Gulf coast.

No one is justified yet in drawing hard and fast lines on the proper cultural distribution of the various species. A great deal of testing, trial, and experimentation is necessary to settle many

questions as yet imperfectly solved. There are indications that many surprises will develop when adequate experimentation with good representative collections is conducted over a wide range of conditions in different sections of the country. What can be more enlightening and even inspiring than the recent discovery that the rare and almost mythical *Lilium leucanthum chloraster* (fig. 4) persisted in a neglected garden in Michigan while the owner went off to the war for a couple of years, or that the same species has been growing in a private garden in North Carolina for a dozen years? Both of these circumstances indicate commercial possibilities with this unusually beautiful and rare lily which commands almost fabulous prices. One is not now justified in making more than the bare statement that successes on a small scale have resulted in lily culture in the regions mentioned above.

FIGURE 4.—*Lilium leucanthum chloraster* three years from seed. Bellingham Bulb Station

SOILS FOR LILY CULTURE

The writer has not found that lilies are particularly exacting in the types of soils to which they are adapted except that they require a friable loam. If this is considered exacting, then lilies may be so designated, for success can seldom be attained on bakey, plastic clays or lean, loose sands, unless such soils are ameliorated by the incorporation of an abundance of organic débris which will change their texture.

The main work upon which this bulletin is based has been conducted at the United States Bellingham Bulb Station, Bellingham, Wash., and on the Arlington Experiment Farm, near Rosslyn, Va., opposite the city of Washington.

At the time this is written the half-acre planting of lilies on the Bellingham station is located on a strip of land about 350 feet long. One end in its native condition is a heavy dense clay which plows up in big clods, slacking and crumbling on exposure to the drought of summer but running together again upon the advent of winter rains. The opposite end is Lynden gravelly loam. The whole plot has received the same treatment preparatory to growing the lily crop. It was well and frequently tilled, and two very heavy crops of rye and vetch, allowed to get rather hard before being plowed under, were

incorporated. The different varieties of lilies have been planted without reference to their supposed specific requirements. It happens that most but not all bulbs of *Lilium candidum*, *L. testaceum*, and *L. umbellatum* were planted on the heavier soil. Small lots of these species are also on the lighter soil. The lighter soil does not produce as robust growth, and more attention must be given to keep up moisture during the dry July-August period, but good stocks are grown on it. The heavy soil is too retentive of moisture.

At the Arlington farm the culture has been on a coarse, lean sand. It is the writer's judgment that in spite of strenuous effort in that direction it has not been possible to incorporate enough organic matter to make this into lily soil, and that an attempt to accomplish this with large applications of stable manure has interfered in some cases with the health of the stocks. Although success has been had with *Lilium regale*, *L. candidum* has never thrived in this situation.

It should be emphasized at the outset that the greater part of the culture for any crop of lilies should take place before that crop is planted, and it should be possible to put the soil in such condition that it will maintain to a very large degree its porosity and tilth as well as moisture during that crop period with a minimum of subsequent stirring. This means one thing—a large humus content, which is one of the essentials in the successful production of lilies.

It is needless to say that land for lily culture should be well and deeply tilled. In the Bellingham situation on Puget Sound, lily culture is now conducted on 1 acre of land of which one-half is in crop at one time. The bulbs are dug every second year, which means that two very heavy crops of rye and vetch, allowed to develop to the late blossom or early milk stage of the rye, are incorporated. This means a 2-year rotation with cover crops only intervening. It is believed that a longer rotation, which would allow the biennial planting to be done on rotted sod, would be preferable. The criticism has sometimes been made that this is wasteful of land. Without going into a detailed defense of this practice, it may be said that the writer is not at all certain but this is good commercial practice unless it can be shown that humus content and fertility can be brought up more cheaply in some other way. Since areas planted to lilies are comparatively small, it should not be difficult for the grower to plant each time on rotted sod. This is considered best when practicable.

REPRODUCTION

The genus Lilium is surpassed by no group in the variety of ways and the readiness with which stocks may be increased. Even fragments, if properly handled, will reproduce the plant. Various distinct methods are applicable in the reproduction of the different species.

PROPAGATION BY SEEDS

With comparatively few exceptions, lilies are abundant seed producers (fig. 5), and the seed, so far as known, is with still fewer exceptions fertile and grows readily. The most important factor in connection with the propagation of lilies from seed is to know how long it takes the seed to come up. Unfortunately,

information on this point is very incomplete, and a great deal of research will be necessary in order to discover and bring together the essential data on this point.

By this is meant not the actual number of days required for germination to take place, for that will vary with the temperature. The question is much deeper than this. The seed of some lilies has the habit, under some circumstances at least, of waiting until the second year

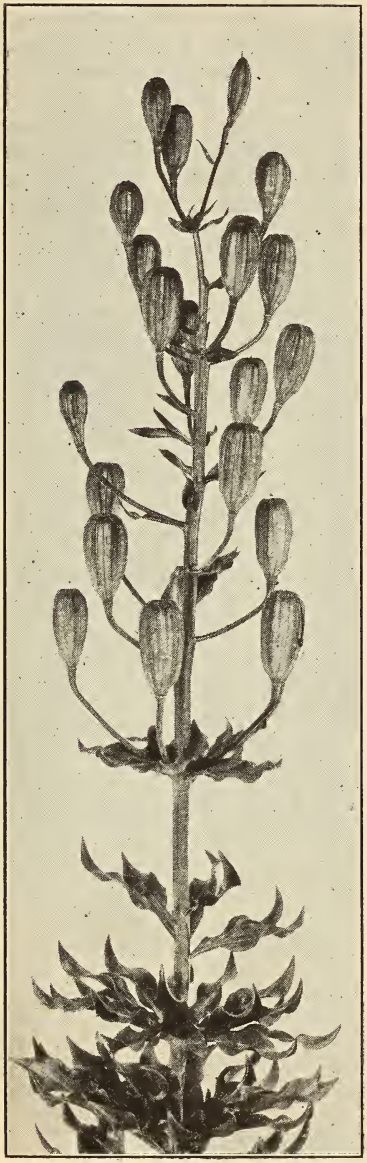

FIGURE 5. — *Lilium washingtonianum* seeding under cultivation at the Bellingham Bulb Station

FIGURE 6.—*Lilium superbum* grown at the Bellingham Bulb Station

before top growth takes place. Often germination takes place the first year with no growth above the surface. This is a characteristic of *Lilium superbum* (fig. 6), *L. auratum*, *L.*

speciosum, *L. humboldti* (fig. 7), and of how many more is not known.

Reproduction by means of seed is especially applicable in lily culture, for the reason that in this genus, more prominently than in most long-cultivated groups of plants, we are dealing with natural species that reproduce true to type. Of course, seedlings of the horticultural varieties are likely to reproduce any variation within the species, or, if of hybrid origin, even a much wider variation.

The handling of lily seed for producing more plants may be as variable as with the seed of almost any other perennial. As with other seed also, the main requisite is proper control of temperature and moisture. The soil should be moist but never soggy, and the temperature is best at about 60° to 70° F.

Practically all lilies from seed receive a very beneficial impetus from an initial greenhouse push. The seed may be sown in November. All varieties that germinate readily will be ready to prick off into 2-inch pots in January, and may be set from these in the field after danger of frost is over in the spring.

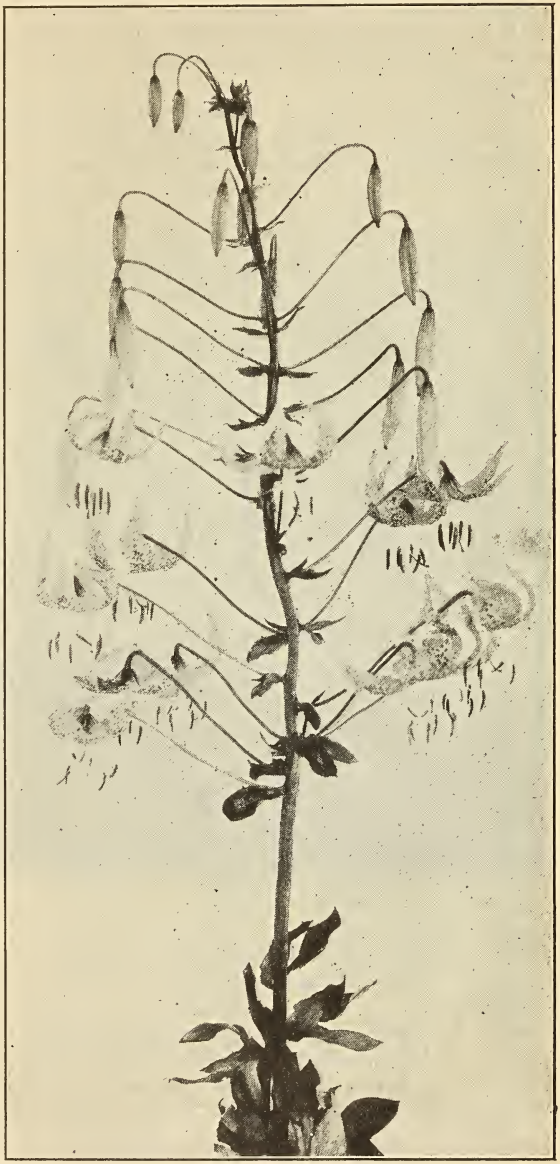

FIGURE 7.—*Lilium humboldti* grown from seed at the Bellingham Bulb Station

Seed is usually sown in flats, pans, or pots (fig. 8) if the quantity is small. The soil should be a porous loam of good fertility with no

raw manures. The conventional compost of rotted sod and sharp sand, with a goodly incorporation of well-rotted organic matter, can not be improved upon. More fertility when needed can well be secured by adding a small quantity of bone meal three to six months before using. Under greenhouse culture the seed need not be covered more than a quarter of an inch with earth, which had better be sieved, and may be of even a lighter texture than the general mass of the soil.

If it is not feasible to transfer the seedlings into pots, they may be transplanted directly into the field from the seed flats if the soil is thoroughly prepared and care is taken. It should be realized that lilies can be transplanted at almost any stage of development about

FIGURE 8.—Seedlings of *Lilium longiflorum*, Arlington Experiment Farm

as easily as the common run of perennials. The pricking off into pots, however, has the advantage of giving a better and more rapid development.

With the vast majority of species, especially in the Pacific Northwest, most lily growers will handle the lilies on an entirely out-of-door basis. This will necessitate care all along the line, but more especially in the preparation of the seed bed. It is particularly important that the soil for the reception of lily seed be as nearly perfectly prepared as possible. It should be of uniform texture. If recently plowed and worked with horse tools there is a likelihood of lack of uniformity and unevenness of surface. The best way to unify, pulverize, and smooth the surface is with a garden rake. (Fig. 9.)

Objections are sometimes heard to this burdensome hand labor in the preparation of the field seed bed, but it is absolutely necessary with such delicate seedlings. After all, the burden is not so great, for the workman who knows how to use a garden rake (few do) will prepare a square rod in 10 minutes. Upon this may be planted not less than 10,000 seeds.

The planting may take the form of long rows, but the writer prefers the conventional 3-foot bed with rows across it at intervals of 3 to 6 inches. Thick seeding is preferred. Six seeds to the inch is about right. (Fig. 10.) This gives the most intense of cultures and furnishes opportunity for mulching or other form of protection which may be demanded later.

The writer employs the Dutch bed method entirely in the planting of the lily seed bed. The soil is removed from the 3-foot bed to a depth of about 1 inch. The bottom of the excavation is then raked level, and the marker, which lays off the rows, is run through. The

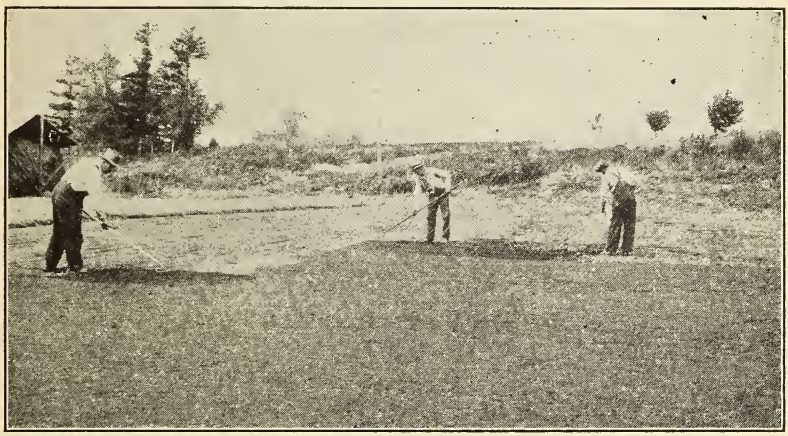

FIGURE 9.—Preparation of the field lily seed bed at the Bellingham Bulb Station. The surface is prepared with a hand rake

seed is best distributed from small tin cups or cans or from cornucopias fashioned from strong, smooth paper. (Fig. 11.) Eighteen inches is about as far as one can conveniently reach, so two boys usually distribute the seed, one from either side of the bed. A quiet day must be selected for planting lily seed, for the task can not be accomplished on a windy one. The seed is covered by shoveling soil enough to bury it 1 inch from the next bed, which is thus opened for planting. After the seed is covered, the surface is again smoothed with the hand rake.

This sets the seed down about 1 inch deep. The reason for the deeper planting outdoors than inside is the greater danger of disturbance by the elements and the difficulty in most situations of maintaining moisture with certainty less than 1 inch below the surface. Were it possible to overcome these two difficulties, one-fourth inch deep would be better.

Recently the operation of seed culture of lilies under field conditions has been considerably refined at the Bellingham Bulb Station.

It has been found that seedlings have difficulty in getting through the soil, which packs very badly and often bakes after the copious rainfalls.

In this plan the initial preparation of the land is the same as before, and the beds are laid out in the same way, but no excavation is made. The marker is run along a taut line. Another hand marker is then employed. This is fashioned from two 1-inch boards. In cross section it has the form of a letter T with the drop 1 inch deep. The lower face of the drop is one-half inch wide. The length of this marker is the width of the planted bed. This is pressed into the soil, thus making a trench 1 inch deep with a bottom one-half inch wide for the reception of the seed, which is distributed as before described.

The seed is covered with specially prepared soil which can neither bake nor pack. The past season this covering has been woods earth composted four to six months with a heavy application of ground

FIGURE 10.—One season's field growth of *Lilium regale* from seed. A 6-inch section of a 6-inch row. Arlington Experiment Farm

limestone thoroughly incorporated. A half inch of this material is spread over the bed, thus burying the seed 1½ inches deep with the loose fluffy material, which, when settled over winter, will have the seed covered about 1 inch.

Attention is called to the extreme care taken to avoid artificially compacting the soil. The compost is wheeled over boards laid in the paths, and no foot is allowed on the planted space even during its preparation.

Such care is well worth while and is not so burdensome as it would at first seem. Two wheelbarrow loads of the compost cover a 45-foot bed, which holds 10,000 seeds.

The planting of lily seed in the open field is largely a Puget Sound innovation. The method is particularly applicable there because the rainfall is mostly gentle and there is moisture at the surface of the ground on most of the soils constantly from September to June. This, coupled with its maritime situation, makes the locality especially favorable for this method of handling lily seed. In regions

subject to heavy, drying winds, beating rain, and droughty periods, the seedlings should be grown in frames and with lath or other shade. Some shade in July and August is an advantage even on Puget Sound, but it has not been employed in the investigations of the Bureau of Plant Industry.

The out-of-door seeding has proved successful in all the months of the year except from May up to the first of August. Seed planted in late August on Puget Sound comes up in the spring a little earlier than that planted early in the spring.

It is difficult to advise the grower whether to plant in the spring or in the fall. There is a little advantage in fall planting ordinarily, but there is also a risk in it. A warm spell of weather which will barely germinate the seed, followed by a hard freeze, will be disastrous. This has occurred in the eastern United States and along the Great Lakes, but less frequently on Puget Sound. The grower

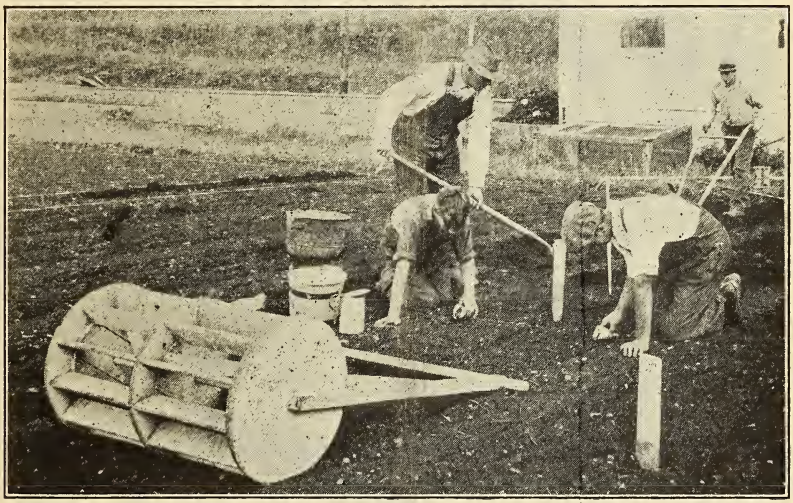

FIGURE 11.—Planting lily seed at the Bellingham Bulb Station

must exercise his own judgment as to the advisability of fall planting in his locality.

The writer prefers to cover the lily bed with rough litter of some sort upon the advent of cold weather. This is raked off in the spring to allow the seedlings to come up. Then some material that will sift in between the plants may be put on for a summer mulch to conserve moisture and keep down the temperature of the upper soil layers. Chopped straw, granulated peat, or even clean sand are all efficacious, but they should not be applied until danger of frosts is over.

There is some indication that a straw mulch may be instrumental at times in furthering the development of the mold Botrytis, which causes fire blight in lilies as in tulips. Much observation and experience are necessary before we can say the final word on the subject of mulches.

A few of the more robust lilies will move along faster if taken out of the seed bed and given more room at the end of the first growing

season or before growth starts in the spring. The majority of them, however, may be profitably left in the seed bed two years. Often it is commercially economical to leave the seedlings of even such strong growers as *Lilium regale* undisturbed two years, even though there may be some sacrifice of growth.

At the end of the first growing season the bulblets of most lilies are delicate and shallow. It is therefore advisable to cover the beds with one-half to 1 inch of soil before the ground freezes. A covering of rough litter can be placed over this and removed in the spring before growth starts, or it may be left on and the plants allowed to

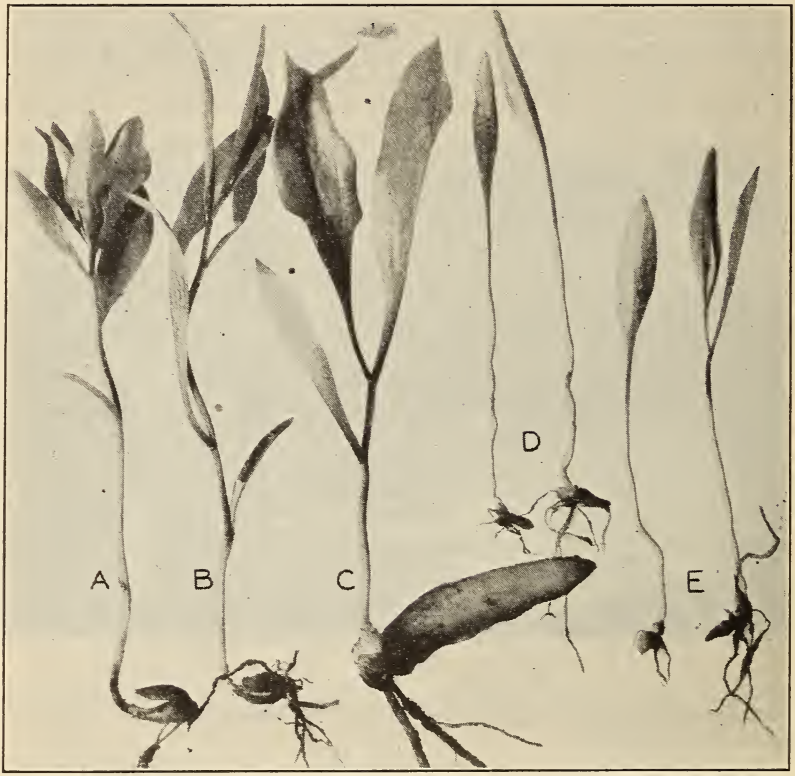

FIGURE 12.—Five west-coast lilies grown from scales planted in July and photographed in April: A, *Lilium washingtonianum;* B, *L. humboldti magnificum;* C, *L. humboldti;* D, *L. parryi;* E, *pardalinum.* Bellingham Bulb Station

come up through it, if there be no danger of hard frosts after the plants are up. It is usually better, however, to remove it to facilitate weeding and to return it later if summer mulch is needed.

PROPAGATION BY SCALES

After culture from seed, the propagation by means of scales is the most important method of increasing stocks of lilies. While not applicable to all, it does apply to many, and a large number are more advantageously grown from scales than in any other way. *Lilium candidum*, *L. testaceum* and some of the western American

group are particularly adapted to this form of handling. (Fig. 12.) Even the common forms of *L. tigrinum* (fig. 13), which come so readily from aerial stem bulbils, seem to grow even better from scales.

As a general rule this propagation should be performed when the lilies are in late blossom. There may be exceptions, but if so the writer has not discovered them. It seems but little short of brutal to ruthlessly dig a beautiful clump of lilies when they are in their prime of beauty, but when this results in increased production it is justifiable.

The bulbs are dug, scaled, and reset in as short time as possible. They should never remain out of the soil more than a few days when dug thus early, for they deteriorate very rapidly. The scales taken off will receive less injury from remaining out of the soil than the bulbs.

No definite general rule can be given for the number of scales to be removed from a bulb. This will vary some with the variety and also with the state of maturity of the bulb when scaled. It has been the writer's practice to scale *Lilium candidum*, *L. testaceum*, *L. umbellatum*, *L. chalcedonicum*, and *L. croceum* bulbs to the crown for the next year's performance. This is too close for *L. auratum*

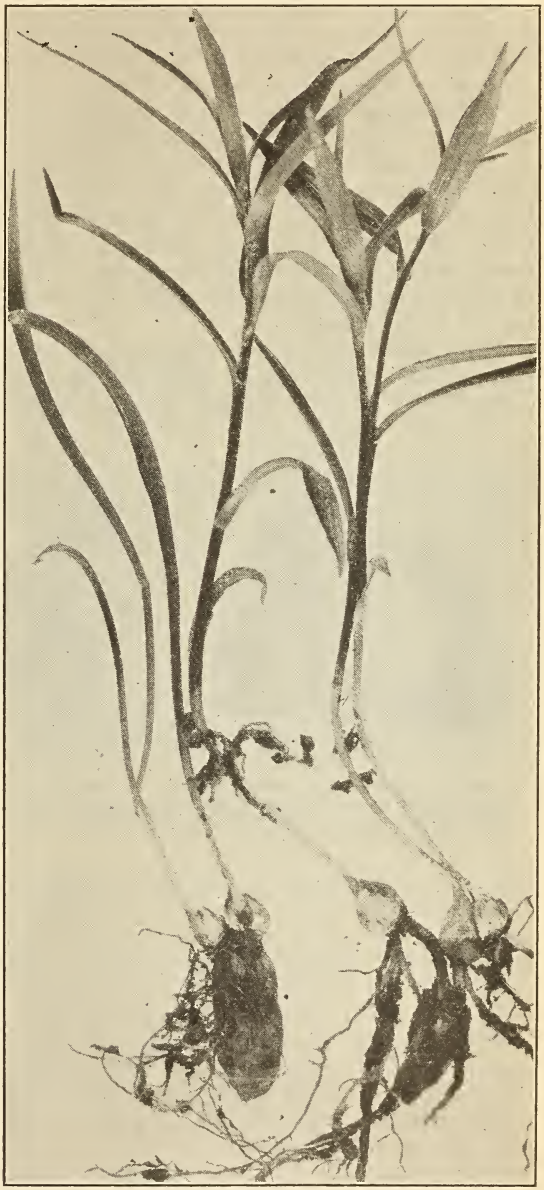

FIGURE 13.—The robust type of *Lilium tigrinum* as developed from scales between July and April at the Bellingham Bulb Station

and *L. speciosum*, but there are no definite data on the subject. The point needs further study.

It is often possible to remove 75 scales from a well-grown bulb of *Lilium testaceum*. The number from *L. candidum* will be smaller, but they will be larger in size and will occupy more space when planted.

Some actual figures on the scaling of *Lilium candidum* and *L. testaceum* at the Bellingham Bulb Station in 1927 will be instructive. In both cases the bulbs were scaled closely in 1925 and remained undisturbed in 1926 except that the stems were taken out in full bloom for propagation. *L. testaceum* yielded an average of 45 scales to the bulb for 1,600 bulbs. One heaping bushel of *L. candidum* contained 60 bulbs weighing 36 pounds with the roots on, and 24 pounds of scales measuring seven-eighths of a bushel were removed from the bushel of large bulbs.

The number of bulblets that may be expected from a scale propagation will vary greatly with the variety and with conditions of culture. (Fig. 14.) Potentially, two bulblets are expected from each scale, one from the terminus of each of the vascular bundles in the broken end severed from the basal plate of the bulb. This ideal, however, is seldom attained. But in experimental planting on Puget Sound a propagation of 150 per cent is expected when the propagation is made in season and under good conditions. In other words, one can rely on an average of one and one-half bulblets to the scale in *Lilium candidum* and *L. testaceum*. The small-scaled species of the western bogs will yield but one bulblet to the scale, but the forms of *L. humboldti magnificum*, with jointed scales, often yield as high as four bulblets to a scale, while the large scales of *L. leucanthum chloraster* often yield as many as five and rarely seven.

FIGURE 14.—*Lilium speciosum* bulblets developed from scales buried in sand in an unheated greenhouse at the Bellingham Bulb Station from August to April. They are now ready for the field

The number of bulblets may be increased artificially in many species if one desires to take a little trouble. A scratch of a pin or the point of a knife blade across the concave side of the scale will often induce the development of two bulblets at each scratch. It may be doubted whether anything is gained by this increase of bulblets, however, for every such increase in number decreases the size of the individual. (Fig. 15.)

How often it is safe to scale bulbs is a mooted question. Frankly, it is not known, because there is not enough recorded experience on the subject. A little experience with *Lilium testaceum* is indicative. A stock of this lily was scaled in 1918, 1920, 1922, 1924, 1925, and 1927. The stems were jerked out of the bulbs at blossoming time every year. The stock in 1918 consisted of four bulbs. In 1927

there were 1,600 bulbs measuring 6 to 10 inches, besides a large complement of small stock.

Another factor is the age of scalable bulbs. Nine hundred 1-year-old bulbs from a scale propagation of *Lilium testaceum* had 3,000 scales removed from them in 1926. In 1927, 2,000 small bulblets were dug—not over one-fourth the size of a normal scale propagation in one year. The bulbs scaled did not make a normal growth. This seems to indicate that there is at least no gain in scaling bulbs of this lily less than 2 years of age, and better 3 years.

After the scaling, the old bulb "hearts" should be reset without delay. On account of the reduction in the size of the bulbs one may err in judgment regarding the space that should be given them. It is safer to space the "hearts" as one would the full-sized bulbs when resetting them, for they are more vigorous and will make a

FIGURE 15.—*Lilium testaceum* propagation from scales which are still attached at the close of the season. From one scale one large bulb has developed, and from the other two smaller ones

greater development the next year than unscaled bulbs the same size as the "hearts."

It is preferable to plant the scales in the conventional 3-foot bed and to handle them precisely as described elsewhere in this bulletin. The bed is excavated only 2 to 2½ inches deep. The rows are prepared 6 inches apart for most species with large scales, but small-scaled species like *Lilium parryi* and *L. pardalinum* (fig. 16) can advantageously go into rows 4 or even 3 inches apart.

One boy on each side of the marked bed attends to the distribution of the scales. They work on their knees in the paths, in the manner described in connection with propagation by seeds and as illustrated in Figure 11. The scales are distributed from small containers by the handful into rows, where there are placed about 50 to the row if the scales are large like those of *Lilium candidum*, but about 100 to 150 to the row if they are small like those of *L. pardalinum*. The crop obtained in this way is phenomenal. (Fig. 17.)

It is usually necessary to go through the paths with a wheelbarrow load of soil after the ground settles, to cover any exposed scales. In the endeavor to secure the necessary shallow planting some scales are likely to be left exposed. These should be covered. It is better to take this extra trouble than to run the risk of too deep planting, which will keep the bulblets from coming through.

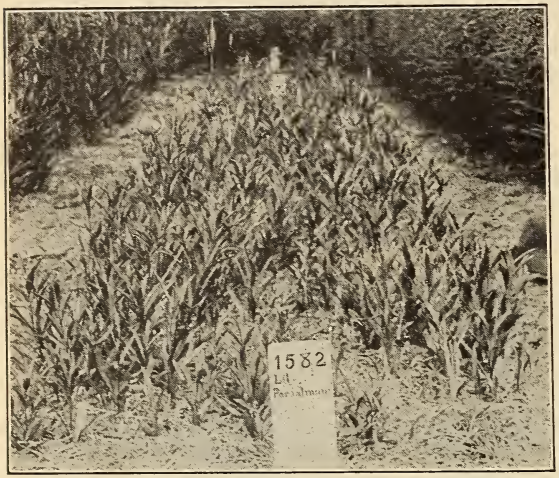

FIGURE 16.—*Lilium pardalinum* the second year from scales. The bed has produced a few blossoms. Bellingham Bulb Station

The success of this method of propagation, with many lilies at least, depends very largely upon the condition of the soil. A comparatively dry but not bone-dry soil is the ideal. If the ground is wet during the first three weeks especially there is danger that the scales will rot. After the broken surface has healed and the bulblets have started to form there is less danger. Should it be necessary to propagate in wet weather, it is safer to do so under cover.

The scales may be strewn thickly on the dirt floor of a shed and covered with dry sand. Alternate layers of sand and scales may be built up to a depth of 10 or 12 inches. No water should seep

FIGURE 17.—*Lilium testaceum* bulbs, a row across a 3-foot bed in place at the end of the first season, as grown from scales. Bellingham Bulb Station

into this propagating ground. The natural capillarity of the soil in such a situation will prevent too much desiccation.

If the grower is provided with a greenhouse, the space under the benches may be inclosed in some convenient manner, and the heat of the sun in the summer, or artificial heat in winter, will accelerate

the development of the bulblets. In such a situation the scales may be buried in dry sand, where little or no attention need be given them, or they may be strewn thickly on the surface of sand and kept constantly moist. If the propagating is done in the open air, it is necessary that most of the light be excluded in some way. (Fig. 18.)

The above descriptions of ways of handling the scales are intended to cover simply the general methods of operation which will serve as a guide. The actual performance may be endlessly varied, especially when the quantity of material is small. The scales may be conveniently buried in sand or other dry earth under a porch. The propagation may be effected in dry or barely moist, well-aerated material such as sphagnum, granulated peat, old redwood, or cedar-shingle tow. The aim should always be to prevent excessive wilting of the scales. If the material is dry, the atmosphere should be moist around the propagation, and, all things considered, this is probably the safest plan for the inexperienced.

The propagation may continue a variable length of time. The advantage of the field propagation results from its saving of labor in that the propagating bed is the permanent quarters of the young

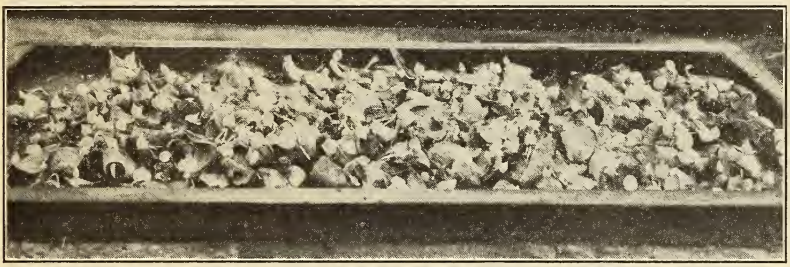

FIGURE 18.—A scale propagation of *Lilium candidum* between November and June under the benches of a cool greenhouse. Arlington Experiment Farm

stock for a year. The other methods necessitate transfer to the field later in the season. This may take place in from 40 to 90 days, depending somewhat upon the rapidity with which the bulblets grow and form roots. The period of propagation, however, is very adjustable. In 40 days, if the temperature is about 65°, the bulblets will be well formed and are better for being moved into their field quarters. But there need be no hurry unless excessive root development, or, as is the case in *Lilium candidum*, top growth, occurs. However, it is necessary, as with stem propagation, to have the young bulblets in their permanent quarters long enough before cold weather to enable them to get a firm hold on the soil by root development before winter sets in.

The field beds of lily scales go into the winter with the young, tender bulblets close to the surface. The greater the development the closer they are. It is therefore essential that they be protected by a mulch of some sort of litter heavy enough to prevent rapid thawing and freezing, which is so destructive in heaving plants loose from their anchorage.

If the young stock is to remain in the propagating beds over the second winter, it is advisable to cover the beds late in the fall with

an added inch of soil. The force of this recommendation will be appreciated when it is noted that the robust species of lilies produce in one year bulblets that measure vertically 1 to 1½ inches. This growth is upward. The scales are put in with only 1 to 2 inches of soil over them.

There is also a great latitude in the time in which propagation by scales may be effected. The writer has removed scales from *Lilium candidum* bulbs in pots in November when they were in full vegetative vigor and has secured good results in boxes of dry sand, the scales with attached bulblets being put in the field in early June. Good propagation has also been made by digging field-planted bulbs in the spring and treating them similarly. The propagated scales were planted outside in July at the time that the lily was in blossom.

FIGURE 19.—Reproduction by means of stem bulblets on stems of old bulbs in *Lilium leichtlini*. Bellingham Bulb Station

The possibility of a fall propagation from scales by layering them in dry sand may be very important at times. Often it is not possible to get the imported stocks until late September, which is too late for field propagation in many sections of the North. The ability to handle the propagation in this way enables the grower to save a year by bridging over a growing season in the propagating boxes, so as to set the small bulbs in the field only a little earlier than the normal time of propagation the next year.

PROPAGATION BY STEMS

The propagation of lilies from buds produced in the axils of the leaves or their homologues, the scales underground, may very properly be considered under two categories, the natural and the artificial.

Both of these methods result in the formation of small bulbs on the stem at or near the surface of the ground.

The natural reproduction by stem bulblets produced on the lower portion of the stem occurs in many species of lilies and can be accelerated by artificial means. In other words, the bulblets are produced naturally mostly underground. If, however, the lower portion of the stem is in a very moist and shaded atmosphere, similar bulblets will be produced aboveground to a height of 2 inches or more.

This form of propagation is well illustrated in Figure 19, which shows *Lilium leichtlini*. Identically the same form of reproduction occurs in *L. umbellatum*, *L. elegans*, *L. dauricum*, and others. In all of these lilies, under cultural conditions, this form of reproduction is much more copious in young bulbs than in old ones. This is due very largely to the fact that the young bulbs are strewn along the row in any position into which they happen to fall, thus causing the stem to travel some distance through the soil before reaching the surface, while the larger sizes are set up and the stem consequently grows directly upward with no bends, leaving a shorter length underground. (Fig. 20.) A crook in the stem underground is a potent factor in inducing the formation of bulblets.

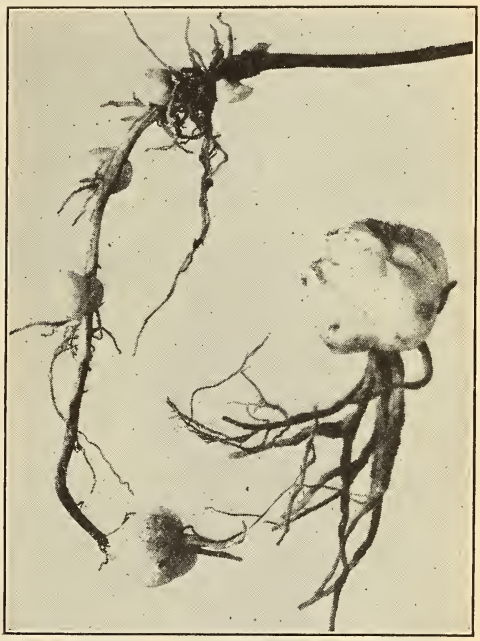

FIGURE 20.—Reproduction by means of stem bulblets on stems of young bulbs in *Lilium batemanniae*. Bellingham Bulb Station

In another group of lilies, such as *Lilium longiflorum*, *L. auratum*, and *L. speciosum*, there is always a considerable formation of stem bulblets on the large stems. Deep planting, banking up earth about the stems at or near blossoming time, application of a mulch, or disbudding will accelerate and enhance the bulblet formation a great deal. In some cases, such as *L. umbellatum*, *L. candidum*, and *L. testaceum*, if conditions are favorable some of these artificial accelerants may induce the formation of bulblets in the axils of the upper leaves in the decapitated inflorescence.

In many of these lilies that form stem bulblets, possibly in all of them, cultural conditions play a very important part in the extent of bulblet formation. Often conditions that are inimical to the best natural development of the plant tend to increase this bulblet reproduction. This is particularly true in *Lilium regale*, wherein a profuse production of these stem bulblets is an almost sure indication of either a poor development or an actual imperfection in the main bulb. (Fig. 21.)

These stem bulblets are an excellent source of planting stock. They are set usually quite thick in their permanent quarters in the field at the time the bulbs are dug. It often happens with *Lilium longiflorum*, *L. regale*, *L. henryi*, *L. speciosum*, *L. auratum*, and others that digging must take place while the stems are still green and before the bulblets are fully grown. In such cases the stems with bulblets attached may be heeled in the field and they will double in size in a few weeks. They may be removed from the old stem bases and planted singly, or the section of the stem bearing the bulblets may be laid in the ground at proper depth. Late disturbance of the bulblets is usually unsafe, for the reason that they fail to make root in cold weather.

FIGURE 21.—*Lilium regale* stem, showing wealth of stem bulblets produced when the plants are in an uncongenial condition

There are some lilies that naturally produce very few or no stem bulblets but may be induced to do so by artificial means. Notable examples of these are *Lilium candidum* and *L. testaceum*. Under normal field conditions the large bulbs of *L. umbellatum* produce almost no bulblets, but a phenomenal reproduction may be induced readily.

The favorite time for stem-bulblet reproduction by artificial means is at or close to the blossoming period. A little variation one way or the other does not seem to matter. Climatic conditions may influence the time to some extent. In the eastern portion of the United States it may be advisable to delay the propagation for a few weeks, but on Puget Sound the shortness of the season requires that little or no time be lost after the plants blossom.

The operation in this propagation is simple. It is usually preferable when a large number of stems are handled to cut off the inflorescence with a sickle to facilitate handling. The stems are then jerked out of the ground. A firm grip is taken on the stem about one-third the way down with both hands. Then with a slight twist and a sharp, quick jerk to one side, the stem is removed. (Fig. 22.) The stems are laid in uniform piles for convenient handling. If there are many of them it is better to tie them into convenient bundles to better facilitate their transportation to the heeling ground. A

very good way is to make the bundles just large enough to occupy a row across a 3-foot bed when heeled in.

Much time and space may be saved by heeling according to a plan. (Fig. 23.) The writer's favorite method is to open with a spade a

FIGURE 22.—Jerking out the stems of *Lilium umbellatum* for propagation at the close of blossoming. Bellingham Bulb Station

trench 4 inches deep across a 3-foot bed. One side of this trench is vertical, and the other slopes at an angle of 45° or less. The stems are laid in this trench with their lower ends against the verti-

FIGURE 23.—Heeling in *Lilium testaceum* stems at blossoming time. Bellingham Bulb Station

cal side, as shown. When the row of stems is complete, another trench is opened 8 to 12 inches away, and the soil is shoved toward the set stems, covering 12 to 15 inches of their bases, thus making another trench with one vertical and one sloping side ready to re-

ceive another row of stems. This is continued until all the stems are planted.

The thickness of setting the stems will vary with the grower's ideas of economy and time, space, and other factors. A few important considerations need to be kept in mind. In the case of very leafy stems, such as *Lilium umbellatum*, thought should be given to a placement which is not so thick that there is a sloughing down of the foliage. In this propagation the object should be, if at all possible, to keep the stems functioning as long as they would if attached to the plant. For best results 25 stems to the row, in rows 1 foot apart, seems to the writer to be the best spacing, although he must confess to a practice wherein 50 stems in rows 8 inches apart prevail.

The length of time for leaving the stems in the heeling ground may vary considerably under different conditions. Attention has been called to the necessity for early vegetative propagation on Puget Sound. It is just as imperative that the stems be taken out of the heeling ground early. If they are heeled in from July 8 to 10, which is the normal time, then August 15 to 20 would be about the right time to remove the bulblets to their permanent quarters. From 35 to 40 days seems to be about the right time under Puget Sound conditions. The bulblets will scarcely make root in this length of time unless they are kept wet, but root growth will begin shortly after this.

If the stems are left in the heeling ground undisturbed for a month longer, much finer bulbs will develop, and the grower is likely to be pleased with the results. The disappointment comes the next season, when the late-disturbed propagation fails to make top growth and lies dormant until the following season without benefit of leafage the first summer. Without leafage, of course, there is no growth beyond the absorption of the substance of the old stem, which becomes inert by November.

Therefore, to succeed with stem propagation, especially with *Lilium testaceum* and *L. candidum* on Puget Sound, the stems should be heeled in early, better before July 10. The removal of the propagation to the permanent field quarters should take place 35 to 40 days later. In a longer season the conditions are not so exacting. The main requisite seems to be to allow sufficient time for the young bulbs to get rooted in their permanent quarters before winter sets in.

When the stems are taken up they will be found to bear bulblets on about 6 inches of their bases. (Fig. 24.) It is advisable to cut off the base bearing the bulblets and plant it as it is.

The amount of reproduction that may be expected by this method will vary with the size of the stems, the climatic conditions, the technic employed in the handling, and the variety of lily. In *Lilium candidum* the propagation should not be less than 20, in *L. testaceum* 12 to 15, but in *L. umbellatum* 50 is usual.

Instead of being heeled in in the field, the stems may be layered in dry earth, preferably on an earthen floor, under cover, so that no rain affects them but where the slight capillarity prevents too great desiccation. (Beneath a porch, in an old shed, or in frames are convenient places for such a propagation.) When the stems are thus buried in earth it is advisable to strip off the leaves, because they slough very quickly when thus smothered, and the rots and molds are likely to be communicated to the stems.

Another method of handling the stems in propagation may be of use to growers having greenhouses or frames with glass, where the temperature and moisture are under a measure of control. If the stems are placed in a moist atmosphere they do not need the earth burial in order to propagate. A good propagation may be had under the benches of a greenhouse with the stems on wire trays, the space closed in with canvas or burlap, and the atmosphere kept saturated by a liberal use of water on the soil beneath. This is very similar to the method used in the propagation of the hyacinth.

The propagation in warm situations, whether under sand or in a moist atmosphere, is much more rapid than under ordinary conditions outside. No more bulblets may be produced, but they develop more rapidly. The bulblets produced by these methods are planted in the field the same as advised for the heeled-in stems under field conditions. They may be planted singly, or the stem bases set as illustrated in Figure 25.

A large number of lilies may be reproduced by stem cuttings. This form of reproduction does not differ in principle from that employed in heeled or layered stems. The technic is a little different, however. The cuttings may be prepared at almost any time until several weeks after the flowering period. (Fig. 26.)

For economy of material the cuttings are best made with three or more leaves, all but the upper one being cut off within a quarter of an inch of the stem. The cutting is then buried in sand in the usual way up to the last leaf, or even the axil of that may be covered, and as many bulblets will result as there are leaf axils in the cutting.

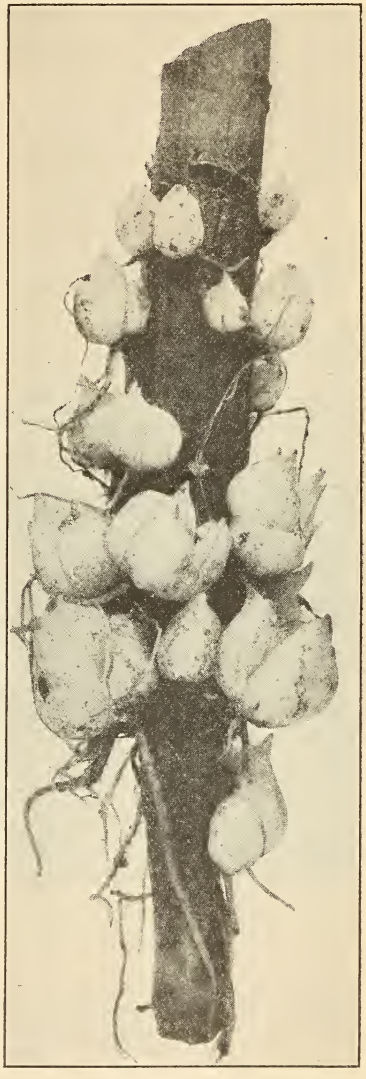

FIGURE 24.—Base of stem of *Lilium testaceum* heeled in the field from July 15 to October 15. About two dozen bulblets have been produced, but no top growth occurred the next summer, owing to late handling. Bellingham Bulb Station

Instead of making cuttings, the grower can remove the leaves from the stem with a good heel attached and set it in sand just deep enough to cover the heel. Bulblets will be formed in the leaf axils just the same as with cuttings.

In the propagation by means of cuttings, the cutting itself does not callus or form roots. The only growth consists of a development of the latent bud in the leaf axil into bulblets. These, however, form roots very young, thus maintaining the cutting through its progeny rather than through its own root system, as in ordinary hard or soft woods.

The reproduction by means of stem cuttings will seldom be resorted to in lilies, but there are circumstances when it may be profitably employed because of its rapidity, although the method is rather laborious as compared with the layering or heeling-in methods.

PROPAGATION BY BULBILS

There are four species of the genus Lilium that produce aerial stem bulbils in the axils of the upper leaves on the stem. The best known of these species is *Lilium tigrinum*, of which there are many varieties. The others, *L. myriophyllum superbum* (*L. sulphureum*), *L. sargentiae*, and *L. bulbiferum* (fig. 27), are less frequently met with.

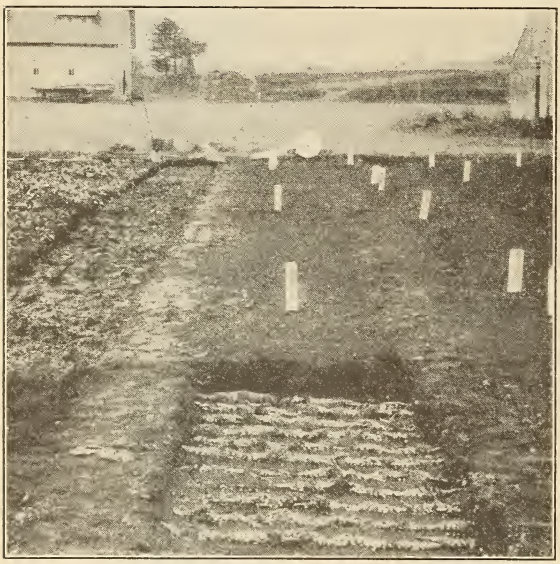

FIGURE 25.—Method of planting stem bases that have been propagated. Bellingham Bulb Station

Experience with these rarer forms is limited, but it may be said that the bulblets may be taken off shortly after the blossoms fade, or after fuller development later in the season, and planted about 2 inches deep. By some they are grown one or two years with frame or greenhouse protection. At the Bellingham Bulb Station it has been found practicable to plant in the open and to mulch. Owing to the short season, the bulblets of the late species often do not get fully developed before the cold wet season begins; consequently, the plan has been adopted at times of cutting the stems and burying them with bulblets attached before the advent of killing frosts. Mulching with 3 or 4 inches of straw has prevented losses thus far, but more rapid development occurs in greenhouse or frame culture.

The bulblets of the various varieties of *Lilium tigrinum* vary greatly in size and time of maturity. The robust form of this species (which is little known in this country) if well grown may produce bulbils 6 to 8 or even 10 centimeters in circumference. (Fig. 28.) The form of our eastern gardens, which is the type of the species, produces bulbils more freely and earlier than *L. tigrinum*

splendens, now imported from Japan. The dwarf variety, the Peh-ho lily of the Chinese markets at Nanking, produces bulbils abundantly, but they are of medium size.

The bulbils are best planted in the open ground about 2 inches deep as soon as they are gathered. A good plan is to drill the bulbils in 6-inch rows across the 3-foot beds, putting in about 35 to the row. If stock is plentiful and only the largest bulbils are used, they may be set up about 11 to the row and can then remain undisturbed two years.

The largest bulbils of the giant form of this species have been known to flower the first year. Usually stems grow the first year from 50 to 75 per cent of the larger bulbils and rosettes of basal leaves from the remainder. The second year a setting of the largest bulbils 11 to the row will all give one to six flowers, and the bulbs will be ready for the market. (Fig. 29.) A good reproduction in the shape of stem bulbils will be produced the first year from stems that do not blossom.

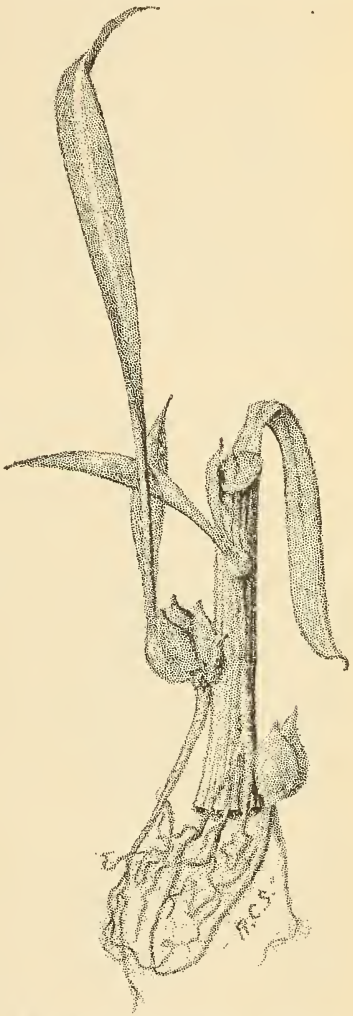

FIGURE 26.—Propagation by stem cuttings in *Lilium longiflorum*. Arlington Experiment Farm

PROPAGATION BY DIVISION OF THE BULB

Propagation by division of the bulb takes place naturally in nearly all lilies. (Fig. 30.) Only in the occasional species, however, is the method of significance to the commercial grower, although it is of great importance to the private gardener who does not wish to dig except at infrequent intervals. Under such handling the bulbs split slowly in most instances and allow a small increase of stock at each 4-year or 5-year period when the bulbs are lifted.

In a few instances this method of reproduction is important enough to be taken advantage of by the commercial grower. The dwarf variety of *Lilium tigrinum*, the Peh-ho of the Chinese Nanking markets, makes a wonderful reproduction by this method. A small triangular bulb only 1 inch in diameter will commonly increase to 2 inches and have five or six noses with one year of good culture.

In the case of collected bulbs, great dependence is placed to-day upon bulb division. *Lilium pardalinum*, *L. parryi*, *L. superbum*,

L. canadense, *L. humboldti magnificum* and others give such an increase by this method as to make it of importance in this kind of handling, but when growers take up the culture of these species, as will have to be done if they are to be enjoyed much longer, other reproductive methods will be employed. As in other nursery business, it may be expected that a progeny will be grown to meet the demands of the definite future season, so as to give the consumer a bulb grown up to just the required size and age.

METHODS OF PROPAGATION MOST APPLICABLE TO EACH SPECIES

In Table 1 an attempt is made to indicate the methods that have been found applicable in the reproduction of the species listed. The list is by no means complete, but it is long and varied enough to serve as a guide with these most common ones and will prove suggestive for the remaining species which are closely related to some of these. It represents as near as may be our present experience. The tabulation is presented as a working basis. It is subject to corrections and additions, but will be useful especially to growers of limited experience.

TABLE 1.—*List of lily species, with methods of propagation*[1]

Name of species	Pronunciation	Seed	Scales	Heeled or layered stems	Underground bulblets	Aerial bulbils	Common name
Auratum	Au-rā′-tum	××	×		×		Goldband.
Batemanniae	Bāte-man′-nī-ī		×		××		Batemann.
Bolanderi	Bo-lan′-der-ī	××	×				Thimble.
Browni	Brown′-ī	××	××				Browns.
Bulbiferum	Bul-bif′-er-um	×	××			××	Bulbiferous.
Canadense (fig. 31)	Can-a-den′-sē	××	×				Canada.
Candidum	Can′-dī-dum		××	××			Madonna.[2]
Cernuum	Cer′-nu-um	××	×				Nodding.
Chalcedonicum	Chal-ce-don′-ī-cum	×	××	×			Chalcedonian.
Columbianum	Co-lum-bī-ā′-num	××	×				Columbia.
Concolor	Con′-col-or	××					Redstar.
Croceum (fig. 32)	Cro′-ce-um	×	××	×	×		Orange.
Dauricum	Dau′-rī-cum	×	××	×	×		Candlestick.
Delavayi	De-la-vā′-ī	×					Delavay.
Elegans	El′-e-gans		××	×	×		Thunberg.
Giganteum	Gī-gan′-tē-um	××					Giant.
Grayi	Gray′-ī	××	×				Grays.
Hansoni	Han′-son-ī	×	××				Hanson.
Henryi	Hen′-ry-ī	××	×		×		Henry.
Humboldti	Hum-bōldt′-ī	×	××				Humboldt.
Japonicum	Ja-pon′-ī-cum	××					Japanese.
Kelloggi	Kel′-log-ī	××	×				Kellogg.
Leichtlini	Līcht′-līn-ī		××	×	×		Leichtlin.
Leucanthum	Lu-can′-thum	××	××		×		
Longiflorum	Lon-gī-flō′-rum	×	×		××		Easter.
Maritimum	Ma-rit′-ī-mum	××	×				Coast.
Martagon	Mar′-ta-gon	××	×				Martagon.
Michauxi (Carolinianum).	Mī-shō′-ī	××	××				Carolina.
Monadelphum	Mon-a-del′-phum	××	×				Caucasian.
Pardalinum	Par-da-lī′num	××	××				Leopard.
Parryi	Par′-rȳ-ī	××	××				Lemon.
Parvum	Par′-vum	××	××				Sierra.
Philadelphicum	Phil-a-del′-phi-cum	××					Orangecup.
Philippinense	Phil′-ip-pīn-en′-sē	××					Glade.
Pomponium	Pom-pō′-nī-um	×	××				Little Turkscap.
Pseudotigrinum	Su′-do-tī-grī′-num	?	××				Thayer.
Pyrenaicum	Pī′-re-nī′-cum	×	××				Pyrenean.
Regale	Re-gā′-le	××	×				Regal.
Roezli	Rē′-zel-ī	××	××				Roezl.
Rubellum	Rū-bel′-lum	××	×				Rubellum.

[1] The methods that have been found worth while and applicable to each species are indicated by crosses (×). Those that have given the best results are indicated by two crosses (××).

[2] Also called St. Joseph, St. Andrew, Annunciation, etc.

TABLE 1.—*List of lily species, with methods of propagation*—Continued

Name of species	Pronunciation	Seed	Scales	Heeled or layered stems	Underground bulblets	Aerial bulbils	Common name
Rubescens	Rū-bes′-cens	XX	X				Chaparral.
Sargentiae	Sar-gen′-tī-ī	X				XX	Sargent.
Speciosum	Spē-cī-ō′-sum	XX	XX		X		Speciosum.
Sulphureum	Sul-phu′-rē-um		X			XX	Sulphur.
Superbum	Su-per′-bum	XX	XX				Turkscap.
Tenuifolium	Ten-u-ī-fō′-lī-um	XX					Coral.
Testaceum (fig. 33)	Tes-tā′-cē-um		XX	XX			Nankeen.[3]
Tigrinum	Tī-grī′-num		XX			XX	Tiger.
Umbellatum	Um-bel-lā′-tum		XX	XX	X		Umbellatum.[4]
Wallacei	Wal′-lace-ī	X	X		XX		Wallace.
Washingtonianum	Wash-ing-tōn-ĭ-ā′-num.	XX	X				Washington.[5]
Willmottiae	Will-mot′-tī-ī	XX	X		X		Willmott.

[3] Also known as Excelsum and Isabellinum.
[4] The name Umbellatum was first applied to an American lily. As here used, however, it refers to a group of European lilies of hybrid origin.
[5] Also known as Santiam and Mount Hood.

MAKING THE SEED CROP

Most lilies are abundant seeders. There are, however, notable exceptions, the most prominent of which are *Lilium candidum*, *L. testaceum*, *L. tigrinum*, and *L. myriophyllum superbum* (*L. sulphureum*). Even these may be made to produce seed at times by proper handling. *L. tigrinum* is said by some to demand foreign pollen to effect fertilization, but in some situations, especially in the British Isles, it is said to produce seed regularly. In some gardens both *L. candidum* and *L. testaceum* regularly produce some seed. What the factors are here is not known, for both usually produce no seed. It is possible to make some of these species produce seed by careful hand-pollination. In some cases heroic measures succeed. These measures consist in jerking the stems out of the ground in early flower, resetting them, preferably a little deeper, watering carefully to reestablish them, and pollinating as the successive flowers open. It is reported that *L. candidum* has been seeded in vases of water by a comparable manipulation when stems were cut as the early flowers opened.

It is found that most of our native lilies set good crops of seed without artificial pollinations (fig. 34), but many foreign ones do not. It is consequently advisable to hand-pollinate these when seed is desired. Some of them set a little seed naturally, but artificial pollination is necessary for a good crop. This is conspicuously true of both *Lilium regale* and *L. longiflorum*, the former withstanding close fertilization while the latter commonly seems to refuse to produce unless there is a wide variation in the parental heritage.

The quantity of seed per plant varies greatly with the variety. Instances have been noted where *Lilium regale* produced 22 well-filled seed pods yielding over 400 seeds each. The pods of *L. speciosum* yield about 300 seeds, while a well-filled pod of *L. auratum* will contain 700 or more. (Fig. 35.)

Many of the late-flowering species, such as *Lilium speciosum*, *L. auratum*, and *L. leucanthum chloraster*, are not satisfactorily seeded in our northern latitudes. (It is very rare that seed of any of these on

Puget Sound has been matured, but they commonly seed at Portland.) Indeed, it is very seldom that frost is late enough in the vicinity of Washington, D. C., to mature it naturally and perfectly outside. For this reason the northwestern growers who wish to produce such species from seed may have to depend on outside sources of supply.

FIGURE 27.—A nonflowering stem of *Lilium bulbiferum*, showing the abundance of bulblets produced. Bellingham Bulb Station

Fortunately, much can be done to assist nature in the maturation of lily seed, thus enabling the grower with a little effort to push the production northward much beyond its natural limit. In the region of Washington, D. C., both *Lilium auratum* and *L. speciosum* often have seed too green to grow when the first killing frosts arrive. Usually the seed pods will go on and develop after the leaves of the plants are all killed, and the earliest of them will mature their seed. However, if the stocks are cut just before the frosts and stood in vessels of water inside they will all mature. As this is being written the writer has just finished gathering such a crop of seed of both of these species (December 1), the stems having been in vessels of water in the greenhouse more than a month.

PREPARING STOCKS FOR PLANTING

In commerce all roots are trimmed from lily bulbs. It has not been the practice in these investigations to molest them except occasionally at the Arlington Experiment Farm, where the practice has not been uniform. It is not felt that it makes a great deal of difference one way or the other. It takes labor to trim the roots, but the setting is more easily done when they are cut. When resetting takes place immediately many of the roots reestablish, and it is thought that there is some advantage from leaving them uncut, but the difference is not great.

Sizing of lily bulbs is done by hand. It would require a complicated machine to do the job mechanically without injury. In the

investigational work of the Department of Agriculture it has been the practice to make two or three sizes, depending on the nature of the bulbs. It may be advisable at times to make more than three.

In the work of sizing it is preferable to spread the bulbs out on a table before one and pick out one size and then another, leaving the balance on the table to go into a third class. This plan is found to be much more satisfactory than attempting to handle all the bulbs by sorting all the sizes at one time.

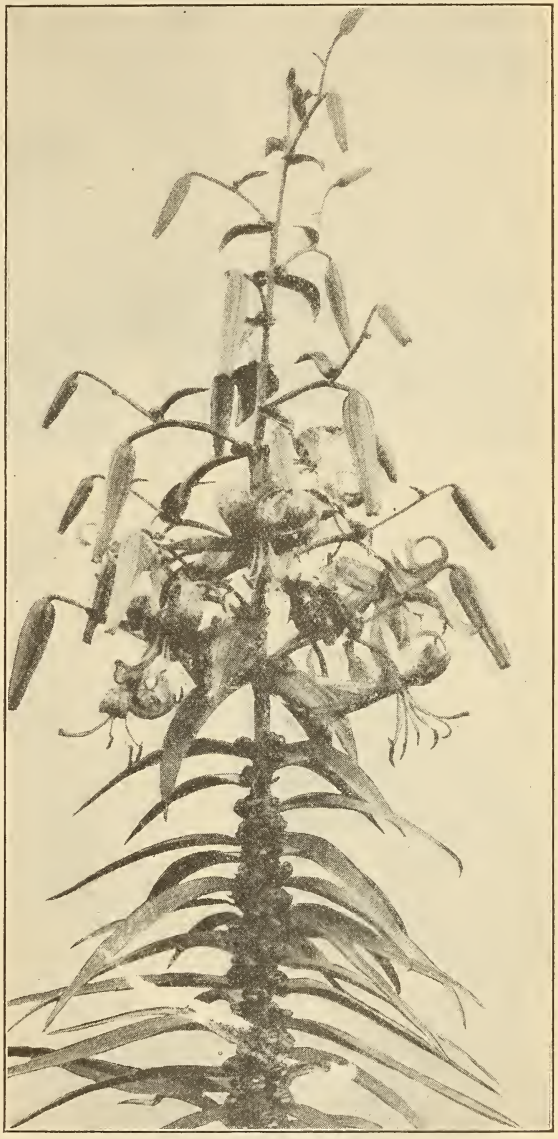

FIGURE 28.—The robust form of *Lilium tigrinum*, showing the wealth of bulbils produced. These often grow to 6 to 8 centimeters (2⅖ to 3⅕ inches) and sometimes to 10 centimeters (4 inches) in circumference and occasionally blossom the first year. Bellingham Bulb Station

PLANTING

The tendency in this country is to discard the bed system of planting in favor of planting in rows. Both systems have their devotees and each has its advantages and disadvantages. Which will eventually gain the ascendency for lilies remains to be seen.

If the row method is employed, the land may be laid out with a small plow, a single-shovel cultivator, a middle breaker, or some similar tool. The large bulbs must then be set mostly with a trowel and the small ones strewn along the row without definite placement. The large bulbs are placed 3 to 8 inches apart and the small ones 1 inch or even less. The furrows may be filled in various ways, as seems most convenient.

FIGURE 29.—*Lilium tigrinum* the second season from stem bulbils. Bellingham Bulb Station

The planting in beds does not differ essentially for a great variety of bulbs. In general, the beds are laid off 3 feet wide, as long as the width of the plot, and alternating with 18-inch paths. The soil is thrown out of the first bed to a depth of about 4 inches. The bottom is then raked to a level and marked with rows across 6 or 9 inches apart, depending upon the size of bulb to be planted. Whenever possible 6-inch rows are used, but most full-sized lilies grow so large as to require a 9-inch row.

FIGURE 30.—A propagation by the division of the old bulb in *Lilium umbellatum*. This has resulted in two years from a bulb like one of the sections

The setting of the bulbs is again similar to the same operation in other stocks, except that in the planting of large lily bulbs, especially if the roots are on them, it is necessary to set with a hand trowel in order to make them stay in place and also in order to get them placed at proper depth.

The bulbs in a bed are covered with the soil excavated in the opening of the next bed, and so on over the plot.

Large lily bulbs, as stated above, may be planted in rows 9 inches apart, and there may be from 5 to 9 planted to the row. Small bulbs of practically all varieties are most advantageously set in 6-inch rows and 9 to 50 of them put in the row. The smaller sizes are strewn along without definite placement, but preferably always in rows. Scales are planted like the bulbs except that the beds are excavated only about 2 inches deep and 50 to 100 or more are planted to a 6-inch row.

FIGURE 31.—*Lilium canadense*, one of the most chaste of native American lilies

ROW AND BED METHODS CONTRASTED

The row method of handling permits of keeping down weeds with horse-drawn implements. This is its chief advantage. If high humus and high fertilizer content are maintained, there is decided economy in a thick and exhaustive cropping over a small area rather than a thin, light cropping over a large one. It may be economically possible to put one-half acre in proper physical condition to grow 50,000 bulbs, while not profitable to put 1½ acres in similar condition to grow the same number. It would seem that the thick planting is more economical of both fertility and mulching materials.

In row planting and horse cultivation, care must be taken not to interfere with the stem roots. This necessitates hand weeding in the rows. It does not, however, apply so much to *Lilium candidum* or *L. testaceum*, which do not generally produce stem roots. Again, in the case of *L. longiflorum*, where it is desirable at times to increase the stem propagation, it may be advantageous to plant in rows so that banking of the soil around the stems can be practiced from the time the plants come into blossom.

MULCH

It is felt that a winter mulch is not imperative in the handling of mature bulbs, except for a few lilies, in either the Puget Sound or the Virginia location. Mulching, however, has been resorted to frequently in the former location where straw has been used for protection and in the latter, where rough, straw manure was added, mainly to give additional fertility. There is no question about the beneficial effect of a mulch, and it may be economically justifiable. On small stock which is shallow it is a necessity. Experience at present does not warrant positive or final pronouncements.

FIGURE 32.—*Lilium croceum*, rare in American gardens, but a fine lily and easily grown

A summer mulch is important in much of lily culture. Large stocks may be so spaced that the plants shade the ground, obviating to some extent the necessity for further protection; but small bulbs, scale propagation, and seedlings receive great benefit from even a slight covering of the soil.

On Puget Sound short straw and screened native peat are two available substances that serve admirably. Not only is the temperature of the soil decidedly reduced, but moisture is kept at the surface as well, two very important considerations in any lily culture, but more especially in the handling of seedlings. In the Virginia situation, spent manure from sweetpotato hotbeds has been put on after the ground was frozen and left on during the summer. The necessity for a summer mulch is less pronounced in regions having uniformly low temperatures and reliable optimum moisture conditions.

There is one season and one condition during which a mulch of litter may be harmful. This is in the spring and in a region having sudden drops of temperature below the freezing point after the plants are up. It is found by temperature readings that it is colder

by about 4 degrees on top of an inch of straw mulch than on bare ground close by.

This becomes of very great importance not only on Puget Sound, where spring frosts are likely to occur, but in the South, where certain lilies, particularly *Lilium longiflorum*, find growing weather interspersed with treacherous drops in temperature below the freezing point. When the plants are up they suffer more when they penetrate a mulch covering. This is due not only to the fact of an actually colder temperature on top of the mulch, but as much to the higher temperature which obtains on top of the mulch during the sunny forenoon following.

The lily grower must govern himself according to his conditions in the application of a mulch, ever remembering that exaggerated injury may result in springtime from allowing the plants to come up through a mulch on frosty nights, if his spring is likely to lapse back into winter on an occasional night.

FIGURE 33.—*Lilium testaceum*, a prolific, easily grown, scarce lily. Bellingham Bulb Station

CULTIVATION

The bed method of planting presupposes a minimum of cultivation. Weeds are removed by hand, and a hand-weeding tool of some kind is commonly employed to barely scratch the surface in the spring as weed seeds germinate. In the fall a wheel hoe may be run over the entire planting to maintain perfect freedom from weeds until winter prevents their growth. The paths between the beds are kept cultivated with a wheel hoe to counteract the packing of the soil.

In the row method of handling, cultivation must be practiced as often as necessary to keep down weeds and maintain tilth. For horse cultivation 36 inches of space is necessary between the rows and 18 to 30 inches for wheel-hoe cultivation.

DIGGING

The digging of lilies is done the same way as with Dutch bulbs, by using a short-handled spade. The bulbs are so easily bruised and injured that it is doubtful whether any other than the hand method of digging will be efficient, unless they may possibly be plowed out when in rows. A spading fork also makes a good digging tool. At the Bellingham Bulb Station, however, the members of the crew are so accustomed to working on their knees with the short spade in the digging of Dutch stocks that it comes very natural to dig lilies the same way.

FIGURE 34.—Pollinating the flower of *Lilium longiflorum* to insure a seed crop. Arlington Experiment Farm

Before mature stocks of lilies are dug, the stems are gotten rid of either by jerking them out or more often by mowing them with a scythe. (Fig. 36.)

Any soil adhering to the roots is shaken off carefully without injuring the bulbs, which are placed in containers to be carried to the bulb house to be worked over and sorted. The hand screens, which are shallow, wire-bottomed boxes, used to screen out soil from Dutch stock, are used here as receptacles only. Lily bulbs are never screened over a wire mesh. Soil adhering to the roots is generally shaken off by hand.

FERTILIZERS

Animal manure, liberally applied, is recommended as the best possible fertilizer for lilies if the grower is sufficiently expert and careful in handling it. If a choice is offered, cow manure is preferable on account of its slower action. In these experiments stable manure has been employed liberally at times, but not always without injury in the form of basal rot. Pulverized sheep manure has also been used at the rate of 50 pounds to a bed 3 by 40 feet as a top-dressing a few weeks after planting.

At other times, when the crop was to remain two years, bone meal at the rate of 1,500 to 2,000 pounds to the acre has been thoroughly incorporated in the bottom of the excavated bed at planting time. When the available nitrogen was low, 2 to 5 per cent of the bone meal has been supplanted by tankage.

While animal manures are unhesitatingly recommended, certain precautions are necessary. They should not be incorporated with the soil at planting time, for there is too much danger that, owing to poor mixture, there may be lumps of the manure too close to the bulbs. This always means disaster.

The ideal way is to apply the manure the previous year to vegetables or other intertilled crops. If the land can be spared, nothing can be better than to apply manure liberally to a previous green-cover crop to be turned under four to six weeks before planting the lilies.

If chemicals are considered necessary they may be safely used in the form of complete high-grade fertilizers. On Puget Sound, where the soils are especially low in phosphoric acid, this element has been emphasized by the use of superphosphate applied mostly as a top-dressing and disked in on top of the cover crop of rye plowed under six weeks before the lilies are planted.

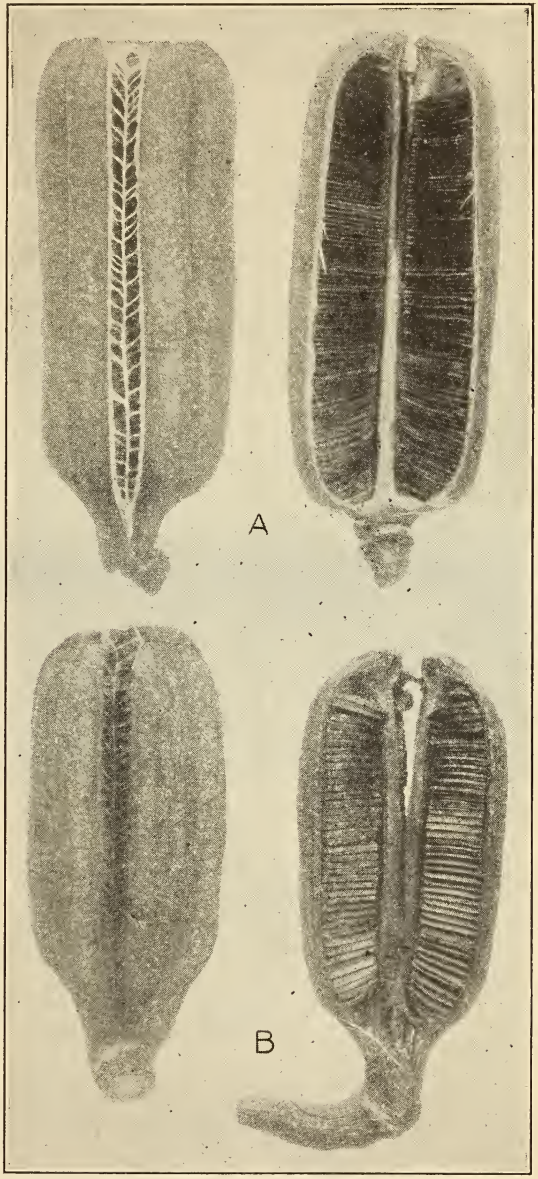

FIGURE 35.—Seed pods of *Lilium auratum* (A) and *L. speciosum rubrum* (B). Arlington Experiment Farm

Under present conditions it is certain that the safest thing for the inexperienced grower is to depend for his fertility in lily culture on cover crops supplemented by artificial manures in which linseed, cottonseed, or soybean meal or some other organic sources furnish a part of the nitrogenous ingredient.

The bulb station at Bellingham, Wash., it must be remembered, was recently in forest. The lilies have been grown both on areas that have received 2 tons of ground limestone to the acre and on those that have received none. No carefully checked comparisons have been made, but the lilies have grown satisfactorily on both soils and so far as observed have done as well on the one as on the other.

DIGGING FOR MARKET COMPARED WITH DIGGING FOR PROPAGATION

A sharp distinction should be drawn between the lifting of lily bulbs for scaling and other forms of propagation and digging for the market. In the former, both the bulbs and the scales are to

FIGURE 36.—Getting rid of lily tops with a scythe preparatory to digging. Bellingham Bulb Station

be replanted at once. Marketable materials, on the other hand, must be able to withstand a considerable period out of the soil. Those reaching our shores from Japan must travel half the circumference of the earth and then in many instances remain in the pack for 3 to 12 months longer. To withstand such treatment, the bulbs should be allowed to mature as much as possible, and the storage period should be shortened by leaving the bulbs undug until thoroughly mature.

It should be noted that in spite of the necessity of thorough maturity for best keeping quality, commercial stocks of some varieties are often dug prematurely. In the case of imported bulbs dug early, the difficulty is obviated to some extent by packing in soil, thus simulating the natural conditions in a measure at least. A great many of our native lily bulbs which are dug from the wild and offered for sale in considerable numbers each fall are prematurely dug, for the very good reason that they are so much more easily found than after the tops have more or less lost their character. The best collectors cache their stores deep in soil as

soon as possible after collecting, keeping them there until shipping time. The bulbs thus mature and make much better stock than if kept exposed to atmospheric influences. Indeed, it is usually not possible to keep these bulbs without such precautions.

It is difficult to state just when a lily bulb is mature. It may be considered ready for propagation when the plants are in blossom, and bulbs may be dug for scaling and reset at this time. Maturity in most ordinary circumstances is arrived at in plants when the seed is ripe. If this rule is applied to lilies, there is a spread of two months between an apparent maturity for propagating purposes and maturity for the market. When such criteria are applied to *Lilium candidum* and *L. testaceum* the speculation becomes very interesting. It has been shown that *L. candidum* is best propagated at blossoming time. The species must also be dug for the market soon after. The seed does not mature until two months or more later, when the species has already become vegetative in preparation for the next season's performance.

Young bulbs should generally be left until late in the season before being disturbed. They commonly rot if transplanted at the close of blossoming.

It will be seen that the question of maturity becomes largely an academic matter. Practically, the behavior and characteristics of the different items or groups of items must be learned and complied with. It is not practicable to lay down rules applicable to the maturity of the bulbs of the whole genus, although the vast majority of lily bulbs may be considered mature and keep best in storage when dug late in the season about the time the seed matures.

FASCIATION

Fasciation is the term used by the botanist to designate certain abnormalities that occur occasionally in especially vigorous lily and other plants. It often happens that the stems of lilies become enlarged and flattened, their internodes shortened and congested, and their inflorescence very much augmented. It is not uncommon for the number of flowers to become four or more times the normal number. Figure 37 shows a stem of *Lilium umbellatum* with 38 flowers instead of the normal dozen. Similar abnormalities are prone to occur in many species, particularly in *L. auratum*, which has been known to produce 250 blossoms on a single stem.

Such monstrosities are usually looked upon as an expression of abnormal vigor. In many cases, at least, increased fertility will bring it on and continue the phenomenon from year to year in *Lilium umbellatum*. In other cases, particularly in *L. auratum*, the phenomenon seems to be more transitory in that it is not known to persist more than a single season, the bulb almost invariably splitting up so as to produce little or no blossom and no fasciation the second year. Often the bulb disappears after the year of fasciation.

FREQUENCY OF DIGGING

The advice of the books is to leave lilies alone so long as they are doing well. This may be fairly good for the ornamental planting, but it is only fair even then, for after the lilies begin to fail there may be a deterioration that can not be overcome for a year or two.

While it is not the desire to dogmatize on a definite time for leaving plantings undisturbed, it is believed that the greatest danger is from leaving lilies in ornamental plantings too long. Most lilies should be moved oftener than is customary and the bulbs cleaned of old débris,

FIGURE 37.—A fasciated stem of *Lilium umbellatum*, with 38 flowers instead of the conventional dozen or 15. Bellingham Bulb Station. Forced on Arlington Experiment Farm

separated, reset, and respaced, for best results, every two to four years. It is fully realized that many will not agree with this view and that there is plenty of evidence in favor of the advice referred to. Ten years of experience, however, forces the conclusion that the commercial lilies especially require frequent digging and resetting.

When it comes to commercial production of the bulbs, frequent handling must be practiced. In general, annual digging should be the rule with four of the big commercial items— *Lilium longiflorum*, *L. regale*, *L. candidum*, and *L. henryi*. (Fig. 38.) There are circumstances, of course, when a year's resetting may be skipped, but as a rule annual handling will be the most advantageous.

It has been shown that a thick planting of either seed, scales, or stem bulblets is the most economical. (Fig. 10.) For best growth the resulting bulbs should receive more room the second year, but if they are spaced enough for two years of development the space occupied the first year after they are transplanted becomes uneconomical, and there is no opportunity for properly putting land in condition and fertility for the last year's growth. Again, in the case of *Lilium longiflorum* in northern climates, the stocks need to be reset annually for the purpose of inhibiting too great growth in the fall and for taking off the stem bulblets which are shallow. These, if not killed, would interfere with the growth of the main bulb next year.

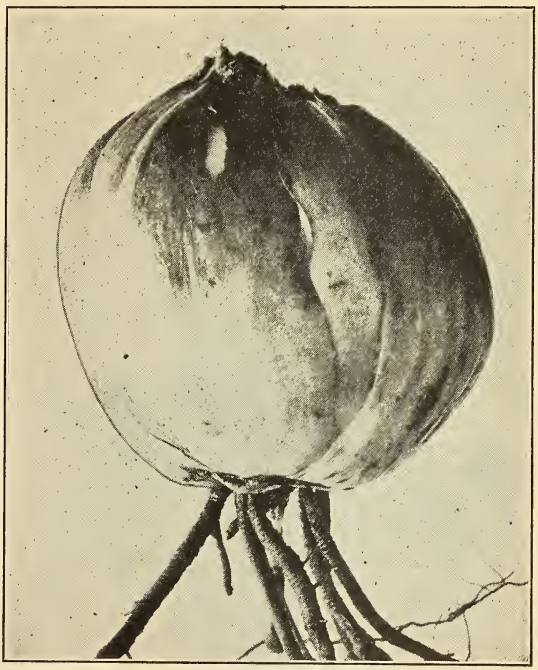

FIGURE 38.—A bulb of *Lilium henryi* 9 inches in circumference. Bellingham Bulb Station

On the other hand, it would seem as though *Lilium tenuifolium* (fig. 39) and *L. concolor* (fig. 40) may more profitably be left undug two years, provided the seedlings are not too thick and the soil is in good fertility. Under such circumstances 25 per cent or more of the bulbs may reach merchantable size the second year. The percentage of salable bulbs, however, will be much greater if the seedlings are dug and spaced at the end of the first growing year.

Species that make a very small bulb the first year, such as *Lilium pardalinum*, *L. parryi*, and *L. washingtonianum*, will be better for remaining in the seed bed two years, because the bulbs are so small that the losses in digging are too great. It has been thought at times in connection with the experimental work of the Department of Agriculture that when only the large bulbils of *L. tigrinum* were planted and set 11 to the row, they could be profitably left undug for two years under good fertility.

These are considerations relating to the welfare of varieties solely. There enters here the very practical question that may influence decidedly the method of operation. The lily grower, like all husbandmen, must economize and conserve his field space. His plantings must be made so that an entire field, plot, or area can be dug at one time in order to effect economic handling. It may, therefore, be better at times to dig some items that might stand another year rather than to have the fields cluttered up by small patches. It is fortunate that there is a great deal of flexibility in the matter.

FIGURE 39.—*Lilium tenuifolium*, adapted to even the northwestern Plains region. Bellingham Bulb Station

It is reported that some European growers dig all lily bulbs each autumn and that many of the species are held in some sort of storage over winter. At least two growers in this country on the opposite sides of the continent have independently arrived at the same method of handling. One was driven to it by poor winter drainage of his soil and the other by a wet winter condition and a very troublesome weed situation. The one stored his bulbs on trays in a frostproof concrete building, and the other, being in a milder climate, stored them in boxes and crates in temporary shed inclosures with a minimum of débris for covering.

The storage of lily bulbs from late fall to early spring is not difficult in a moist, maritime situation where the winter temperatures run from about 25° to 60° F. In moderate masses the bulbs are kept perfectly with a minimum of covering and are planted in the

spring before growth starts. Such handling has decided advantages under some conditions. It may be decidedly advantageous, if not imperative, in regions where the drainage is poor in winter and satisfactory the remainder of the year. Again, if the winters are mild and moist, allowing certain troublesome weeds to grow all winter, growing lilies is very much simplified by storing the bulbs, preparing the land thoroughly, and planting on cleaned and freshly cultivated soil as the growing season starts. This disposes entirely of the very troublesome weed question from September to April and simplifies it from April on.

If conditions are suitable, the bulbs are doubtless better off in their permanent quarters in the soil. However, it is important and interesting to know that success may result from these extra precautionary measures, thus overcoming obstacles existing in some regions otherwise well adapted to lily culture.

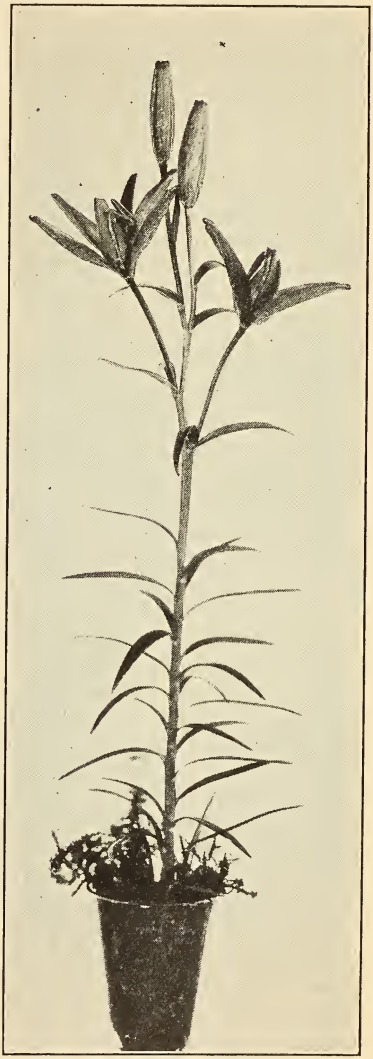

FIGURE 40.—*Lilium concolor*, a good bedder. Bellingham Bulb Station

TIME REQUIRED TO PRODUCE MATURE BULBS

The time required for lilies to reach maturity varies greatly with the species as well as with the method of handling. It is felt that there is not as yet enough published information on the subject to warrant definite pronouncements except on a few species. At least there is not enough experience available to warrant a tabulation of time for each species and method of reproduction. Such a tabulation is much to be desired and doubtless will be possible later. All that is advisable now is a few general comments.

The most common period required for the production of a mature lily bulb may be said to be three years, but it is exceedingly variable and is influenced by many factors. Nevertheless, this may be considered the time most commonly required to develop a full-sized normal bulb.

The old books say that it took about four years to flower *Lilium longiflorum* from seed. Under out-of-door culture it will take two or three years to accomplish the task in Virginia. But if the seed

is started in the greenhouse around November 1 and is kept growing vigorously all winter, blossoming will begin in July, only 7 months from the date of sowing, and will continue throughout the next 12 months if the stocks are repotted for greenhouse culture during the winter.

Lilium concolor, *L. tenuifolium*, and *L. henryi*, if well handled entirely under out-of-door conditions, will give 25 to 50 per cent of blossoming plants in the seed bed the second growing season. Of the first two, 25 to 50 per cent will be large enough to market at the close of the second year's culture from seed.

Lilium regale usually gives a few scattering blossoms the second year. If, however, the seed is started inside in early winter, picked off into 2-inch pots in January, and set in the field in April, bulbs 6 to 7 inches in circumference may be expected at the close of the second growing season. Entirely under out-of-door culture it takes three years to produce the same results.

The evidence is not entirely clear in the case of *Lilium auratum*, *L. speciosum*, *L. superbum*, and *L. humboldti*, for seeds of these species under some conditions at least apparently lie dormant the first year and come up vigorously the second. It consequently takes at least a year longer to produce mature bulbs from seed of these varieties. On the other hand, there are apparently authentic instances in which a few flowers of all of these except *L. superbum* have been obtained the second year from both seed and scales. So the indications are that when the culture of these is better understood their period of development may not be more than a year beyond the average 3-year period. *L. croceum* has blossomed at Bellingham the second year from scales of imported bulbs received in January.

The available information in the case of *Lilium leucanthum chloraster* is very interesting. One private individual receiving seed from China grew the plants for six years entirely under garden conditions before they blossomed. Seed of this same stock grown by the Department of Agriculture, with an initial greenhouse push such as is described on page 9, blossomed the second growing season, only 18 or 20 months from the sowing of the seed. (Fig. 41.) It is very probable, therefore, that this rare, beautiful, and high-priced lily can be easily reduced to the conventional 3-year production basis as soon as a little experience is gained with it and propagating material becomes more plentiful.

To summarize this subject, it may be repeated that the time taken to produce merchantable bulbs of lilies varies from two to four years. In the vast majority of cases the period is three years. There is not a great deal of difference in time in the different methods of propagation. Since the size of the bulb is the best index of the flowering quality, a reasonably good index is furnished by it of the probable quality, and since development in size is almost directly proportional to the perfection of the culture, there may be a great variation caused by this factor alone, as is brought out in the preceding paragraph.

CHARACTER OF MERCHANTABLE BULBS

It is one thing to produce a good show with lilies in either field or garden. It is another and a very different thing to produce the character of bulb best suited for the market. As with so many other plants, the best show does not necessarily mean that the bulbs when harvested will be of the best quality. An old planting of lilies several years of age may be a wonderful decorative success, but it is seldom that such a planting yields merchantable stock, although it may be capital for propagating purposes. Practical growers find that *Lilium regale*, for instance, when spaced from the seed bed to remain undisturbed for the next two years, makes a wonderful show the second season, but that the bulbs when dug are not so large as those obtained from the poorer inflorescence of the stocks dug annually. In short, the bulb grower must aim for the best in bulb production, which often requires the sacrifice of much, if not all, of the floral display.

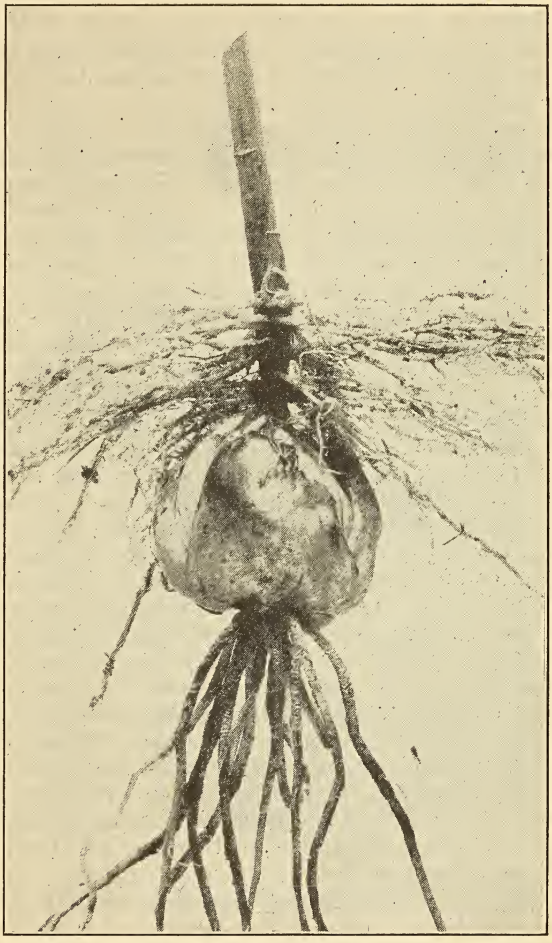

FIGURE 41.—Bulb of *Lilium leucanthum chloraster*, 7 inches in circumference, grown in three years from seed. Bellingham Bulb Station

The imported bulbs of *Lilium longiflorum* from both Bermuda and Japan and *L. auratum*, *L. speciosum*, *L. henryi*, etc., from Japan are the best examples of commercial lily bulbs. A few domestic growers are beginning to put out a good commercial pack, carefully graded, of both *L. regale* and *L. longiflorum*. But the vast majority of the miscellaneous species that change hands are in all sorts of shapes, packs, and sizes.

A sharp distinction should be drawn between planting and commercial bulbs. "Blooming bulbs" is an indefinite term which needs

qualification with a specification as to size. The ordinary commercial sizes of *Lilium regale*, for instance, measure from 6 to 11 inches in circumference. "Planting" sizes may be anything below 6 inches, and blossoming will occur often from bulbs of 3 inches.

The market specifications for commercial bulbs are far from perfect. The lists specify 6 to 8, 7 to 9, 8 to 10, and 9 to 11 inches in circumference. The grade is too wide and permits of too much variation in the quality of a single grade in that the specification of "8 to 10" is fulfilled when all the bulbs are 8 inches in circumference. A difference of 2 inches in the circumference of a bulb is too great for uniform results on the forcing benches or the out-of-door beds.

In no other branch of the nursery business is it more important that the grower understand the period from propagation to maturity than in lily-bulb production. It varies somewhat in the different species and also with the method of handling. It is important because the grower of lilies should aim to let the customer have the advantage of the first mature inflorescence. There is no bulb that is so satisfactory to the consumer as the one that has just reached maturity. This is worth infinitely more than the one that has been grown on in the nursery a year or two beyond maturity and perchance has split into two mediocre, lopsided individuals which present a poor appearance, besides being likely to perform less satisfactorily at the next blossoming.

In all nursery business there is, or should be, a plan to produce young stock that is to go on the market at certain definite future seasons. When such material is not sold the season for which it was planned, much of it is considered fit for the rubbish heap only, and new stocks are grown for the following season's deliveries. Much the same attitude is advisable regarding merchantable materials in lilies. It may never be justifiable or necessary to destroy such stock of lilies, for they can all be used in propagation if they are not sold. However, the principle should govern that in all lilies the best bulb for the market is the one that has just reached the required size when grown with normal celerity from seed, scales, or whatever form of propagation is employed. Bulbs of the same calibration selected from an old planting seldom give as satisfactory results. One of the lily grower's problems is going to be to estimate what he can sell at each of the next two or three merchandising seasons and then to grow stock that will just reach the market size in time for these deliveries.

The aim of the grower should be to plan for a definite turn off at certain future dates. The species of lilies are very dependable in the time they require to come to size or maturity from seed, stem, scale, or bulbil propagation, and under given conditions they may be depended on to make a definite increase in size each year. A progeny grown from any method of propagation is likely to be more uniform and dependable in every way than a mixture of progenies. Sizing should take place in all plantings, so that less of it will be required when the finished product is dug for sale.

Care should be exercised with both undersized and oversized bulbs, particularly the latter, for the reason that the largest bulbs in a pack set the measure for all. These oversized bulbs command a higher

price, it is true, and are greatly sought after at times, it is feared, in order to beat down the price of normal-sized bulbs which constitute the bulk of any culture. Such oversized stocks, in spite of the fact that the few there are of them command a high price, are most advantageously torn to pieces and used for propagation.

PACKING AND SHIPPING LILY BULBS

A few principles need to be kept clearly in mind in getting lily bulbs on the market. They should not be allowed to dry out; they should not be allowed to accumulate moisture through lack of aeration; they should not mold; they should not be allowed to heat in the pack; they should be kept at as uniformly low temperature as possible; and they should receive no mechanical injuries whatever. To meet these conditions should be the constant concern of the grower, the jobber, and the dealer.

For long voyages there is no better method known than that employed by the Japanese exporters. They put mostly subsoil under cover in early spring and work it over to be thoroughly air-dried and pulverized before the bulbs are ready to pack. The bulbs are then set in tight boxes in layers alternating with this prepared earth. They are thus completely surrounded with dry earth which tends to unify the temperature, delays evaporation, reduces the likelihood of bruising, and shuts out the air. The prevention of evaporation of moisture, which prevents wilting of the bulbs without the risk of molding due to the addition of artificial moisture, is the secret of the success of this method. The packing takes place as soon as possible and preferably as soon as the bulbs are dug and sorted. No curing or drying out at all is allowed. Freight charges make such a pack very costly, and it need not be employed except in long voyages.

Formerly lily bulbs were shipped from Japan incased individually in mud and then packed tightly in boxes. This method is seldom used to-day.

In domestic handling, where the bulbs can reach their destination by express within a week, such heavy packs are neither necessary nor advisable. For short distances it is advisable to wrap the bulbs in newspaper and pack them tightly in boxes. For transporting longer distances, when the weather is warm or desiccating influences are severe, a lightweight oiled paper may be used in addition and the bulbs packed tightly in boxes in layers alternating with layers of barely moist sphagnum. This adds no moisture to the bulb but simply surrounds its wrappers with a moisture-laden atmosphere, thus preventing evaporation from the bulb.

Various packing materials may be employed, but they must be of such a nature that they will not absorb moisture from the bulbs. Barely moist fibrous peat or sphagnum work well for small lots shipped a short distance, but it is much better to wrap each bulb in soft paper and then in oiled paper. The writer has had uniformly good results in the shipment of lily bulbs wrapped individually in tissue and paraffined paper and packed tightly in paper cartons. They have uniformly carried well to Hong Kong, China. The bulbs shipped were always perfect and freshly dug. Grain chaff or sawdust are all right for Dutch bulbs generally but have

a tendency to absorb moisture from lily bulbs and consequently are not advisable except for packs of short duration. One shipment of *Lilium regale* was made out of cold storage from Washington, D. C., to Hong Kong. The bulbs were wrapped in tissue and oiled papers and packed tightly in cartons. They had been in storage from January 1 to March 20. They carried perfectly and blossomed well the following summer.

FIGURE 42.—A pure lemon-yellow seedling of *Lilium humboldti*, a handsome new lily

MAKING NEW LILIES

It is considered that there is no group of plants in which the possibilities of improvement are more promising than in the genus Lilium. A tremendous amount of work has been done in the past along this line, and it must be admitted that the net results are not commensurate with the effort. Although there are a number of praiseworthy varieties in cultivation, the hybrid varieties are either few, very scarce, or have disappeared entirely. Recent activity, however, has revealed wonderful possibilities.

The reason for paucity of commercial results from the older efforts is not difficult to explain. No grower has made it his business to work up stock in sufficient quantity so that there is material to insure a wide enough distribution to prevent constant shortage and eventual disappearance. New hybrids have recently appeared, however, and there are many more very desirable ones on the way (fig. 42) which will doubtless be put on the market in a few years. It is to be hoped that the material will be propagated so there will be stock enough to maintain the variety before it is disseminated.

With the widespread activity that is now manifest in several sections of this country, there is little doubt that rapid progress will be made. It is believed that the time will come in the not-distant

future when the native species of lilies will be looked upon in much the same light as native species of the tulip are now regarded. The new and better hybrid forms will be so much superior as to be sought after and will supplant in our gardens the natives that now predominate.

To produce new lilies is not a difficult matter. The main requisite in the breeder is a steadfastness of purpose, a prospective long lease of life, and a business or a competence that will permit the expenditure of effort for the accomplishment of a purpose and not to enable him to eat, for, as usual, remunerative returns are not to be expected.

Among the main requisites are facilities for the handling of large progenies. In Lilium, to possibly a greater extent than in other genera, maternal inheritance is remarkably prevalent in crosses which yield an occasional pronounced hybrid. There is one instance in the writer's own experience in which 2,000 to 3,000 plants resulted from crosses with the variation in the first generation confined to one plant. All lilies do not behave this way, however.

The beginning of the production of hybrids is pollination under sufficient control to insure the exclusion of all pollen except that desired. This process consists of two operations. The flower to be used as the mother must have its anthers removed before they open and shed their pollen. The flower should then be protected, preferably by a gauze covering, to prevent contamination by foreign pollen from insect visitations. The removal of the anthers and the protection of the flower are best performed the evening before the flower opens or very early in the morning as the petals are spreading.

Later in the day when the flower has opened, or perchance as the flowers open, and often any time during the day, the pollen desired should be dusted, or, better, brushed on the stigma. This can be done in various ways. It is most often put on with a soft camel's-hair brush, but the parts of the lily flower are so large that it is about as convenient to pinch off the filaments of the anthers and tap the stigma gently with the anther loaded with pollen. The operation is well illustrated in Figure 34. In the illustration the filament is held between the fingers, and the anther is resting on the stigma. The anthers have been removed from the flower that is being pollinated. This operation is usually performed between 7 and 10 o'clock in the morning, depending on weather conditions. It will vary, however, with different species. *Lilium superbum* awakens early. The anthers have opened and the stigma is receptive by 7 or 8 o'clock at Bellingham, while *L. leucanthum chloraster*, *L. browni*, and the auratums awaken late and may not be ready for pollination before noon.

The gauze or paper covering is returned after pollination and is left on. After three days it is safe to remove it. Often one day's protection after pollination is sufficient, but five or six days of protection will do no harm provided too much heat is not generated under the cover.

The process as described above can often be very much shortened. If one is working with species that do not seed naturally, there is no use in protecting the flower or even in emasculating it (removing the pollen).

The seed produced by such cross-pollination will mature like the ordinary seed of the species and should be grown in the same way as advised in previous pages. If hybridization has been effected there are likely to be great differences in the seedlings when they blossom, and still greater differences are likely when seedlings of these are grown to maturity.

It is after this that the work begins. If, among the seedling progeny, there are plants that are particularly striking, if there are those that are better in one or more particulars than any now grown, they may be made the basis of future named varieties; or the grower may choose simply to grow the best for his own pleasure without making an attempt to work up stock. Stocks should be worked up, however, of all meritorious seedlings for the benefit of other enthusiasts and other lily growers.

The selection from a progeny of hybrid seedlings for basis of stocks of a new variety should always be a single seedling, one plant. No matter if there are two or more seedlings which seem to be alike, it is not safe to use more than one, for different individuals may show more or less variation in future years. If forced under glass, the differences are likely to be still more pronounced.

Stocks of a variety must be worked up vegetatively from an individual seedling by some of the methods described in previous pages. This may seem laborious, and it really is time consuming, but the performance is not so bad as it is to read about it. Stocks of lilies may be worked up comparatively rapidly.

The writer's experience in one instance may be illustrative and worth describing. Hybrid seed was planted under field conditions in the fall of 1918. It lay dormant during 1919 and came up vigorously in the spring of 1920. In 1924 one seedling was selected for the purpose of establishing a new variety. The bulb was scaled closely and planted immediately. It and its progeny were dug again in 1925, scaled, and reset again. It was then left undisturbed until 1927, when a propagation of 1,000 was started. This may be considered as fairly representative of good performance in working up a stock of hybrid lilies. It takes time, but the results are well worth the effort. It is estimated that a propagation of 10,000 ought to be possible from this in August, 1929. With no mishaps, 100,000 plants should be started in 1931.

PESTS

Despite the more or less popular conception, the writer does not look upon the pests of lilies as unusually formidable. There are a number of them, and they do at times cause damage, but the worst enemies of lily bulbs are neither pathological nor entomological, although fungi and insects are likely to be blamed for much of the havoc wrought by high temperatures, bad soil conditions, exposure, abrasion, and desiccation. These are the worst enemies of the bulbs, and enemies that the bulbs can not tolerate. Much of the injury to stocks caused by these agencies is often mistakenly attributed to associated organisms which may be present and conspicuous, while the real culprits are not in evidence.

The following annotated list contains the principal enemies of lilies that have appeared during the progress of these investigations:

Botrytis.—The botrytis mold often attacks lilies, especially *Lilium candidum* and many more, in garden culture where there is too much shade and consequent poor aeration, low temperatures, and humid, stuffy conditions. In the past 10 years little injury has been observed in private gardens of the Puget Sound region. It occurred one year in the writer's shaded planting in the District of Columbia. Botrytis affects the lily much as the same or a closely related organism affects the tulip. The leaves die prematurely, and the buds become moldy and wither. The best preventive is a frequent enough application of Bordeaux spray to maintain a good covering on the foliage. The applications should begin early. Usually, however, the disease gets such a headway before being noticed that a remedy is scarcely practicable, so that all that can be done is to wait until the end of the season when the stocks can be dug and reset under suitable conditions. Such stock is not necessarily predisposed to the disease another year if properly handled.

Damping off of seedlings in the seed bed is another manifestation of Botrytis injury. The remedies here are good aeration and proper control of moisture. The plants should be kept on the dry side whenever there is danger. Watering is best done in the morning, so that the plants are comparatively dry by evening. In aggravated cases, spraying with one of the organic mercury compounds will be of assistance in getting rid of the organism and in checking the damping off.

No trouble has been experienced with damping off under field conditions, but under greenhouse conditions the case has been very different. The grower who starts his seed in greenhouses or frames should exercise extreme care. Overwatering should be avoided, and the plants should be dry by late afternoon.

Rust (Uromyces lilii).—This fungus is at times very annoying. It manifests itself as minute powdery brown areas on the leaves and stems, which may in severe cases become confluent into large patches.

The most effective remedies are sanitation and early and persistent dusting with flowers of sulphur. All débris of old stems and leaves should be removed from the planting before disintegration takes place. When the crop is dug, all old tops should be left behind, and resetting should take place on clean ground. A thorough washing of the bulbs with a strong spray of water as soon as dug and dusting with sulphur after they are dry are also recommended.

Some species are much more subject to rust than others. *Lilium candidum*, *L. humboldti*, *L. parryi*, *L. washingtonianum*, and *L. pardalinum* are particularly susceptible. The native *L. columbianum* is badly rusted all through the Northwest. The writer has observed it in various places around Bellingham, Olympia, and Chehalis, Wash., and Portland, Oreg.

Puffy leaf.—At times certain lilies exhibit a peculiar dwarfed appearance accompanied by a more or less distorted, thickened, and blistered appearance of the leaves. The growing point of the stem may be killed when the plant, although functioning during the season, remains dwarfed and does not blossom. The leaves are much thicker than normal, due to the separation in whole or in part of the epidermis, mainly on the lower side, from the tissues beneath. Often the actual separation occurs between the ribs, and at times only in certain areas, which gives unequal tension and causes distortion.

The cause of this condition is late spring frosts. The lilies particularly subject to the influence are *Lilium hansoni*, *L. regale*, and *L. henryi*. It is not at all uncommon to find it in *L. longiflorum*, *L. candidum*, and the *L. humboldti* group. *L. henryi* is badly affected in the particular location where it is now grown in the Government garden at Bellingham, Wash., but it has done nicely on a ridge 20 feet higher. It is a superb lily in at least one favored private garden which is two weeks later in blossoming than the Government garden; consequently, the plants escape the late frost through not being so far advanced when it occurs.

Limber neck.—The stems of many lilies grown in moist, shady places collapse and wilt a few inches below the growing point following low temperatures after the stems are a foot or two high. The phenomenon was particularly prevalent in the vicinity of the District of Columbia during the season of 1928. Often some imperfection may be noticeable in the root system if the bulbs have been recently imported, and even the base of the bulb may be rotted; this, however, seems to bear no relation to the malady.

Unless the bulb is affected, recovery will take place if the stem is cut off just below the wilted portion, and the remainder will live and function the rest of

the season. The remedy is obvious. Lilies should have their feet in the shade but their heads in the sun. They are sensitive to late spring frosts, especially after a few inches of stem has formed.

Basal and edge-scale rot.—Basal and edge-scale rot is often a symptom rather than a disease. Abuse of a lily bulb is reflected in the base sooner than anywhere else. It is here that the tissues are most subject to injury when the weakened bulb may be attacked by fungi, mites, and other organisms.

The decay may be caused by poor drainage, raw manures, or doubtless assisted or caused at times by microorganisms that have been but poorly investigated thus far.

There are frequently more or less rotted bases present in imported bulbs. It is often possible to eliminate the trouble by cutting out the decayed portion and allowing the surfaces to heal. If the bulb is beyond recovery, the scales, if one-half to two-thirds sound, can be cleaned up and a healthy progeny grown from them. (Fig. 43.) The scales should be cut back to healthy tissue and the surface allowed to dry. They will then propagate like healthy stocks when handled as previously advised under scale propagation. Often even though a bulb is completely disintegrated with basal rot, the scales will reproduce a bulblet or two each if properly handled. If the rotted bulb has live tissue in it there is always hope. Often when bulbs with bad bases have been planted the rot will continue sufficiently to destroy the base, but scales will propagate a healthy progeny in the putrid mass. This has occurred many times in the writer's experience at the Bellingham Bulb Station.

FIGURE 43.—A good propagation from scales of *Lilium candidum* between April and June in a dry sand in an unheated greenhouse. The bulb had failed on account of a rotted base. Bellingham Bulb Station

Aphids.[2]—Considerable injury occurs at times from the inroads of plant lice which attack delicate structures at the apex of the stem, causing malformed parts, distorted or atrophied flower buds, and arrested or crooked stem development. An application of nicotine as advised on the packages of the commercial preparations, or soap spray, or a dusting with tobacco powder are effective remedies. *Lilium auratum*, *L. longiflorum*, and others are very sensitive to attacks of aphids.

This insect is one of the banes of existence of the florist or householder who grows lilies indoors. Constant watchfulness is necessary lest the buds be injured beyond recovery. The remedy in the greenhouse is tobacco, the same as outside. If the aphids are widely spread over the plants a nicotine fumigation is resorted to, but if localized on a few plants a nicotine spray directed into the crown of the infested plants may suffice. The insects are not difficult to control, but it requires constant watchfulness to prevent them from doing injury.

Acrolepia incertella Chambers.—(Determined by August Busck.) This insect, which sometimes feeds on the bulb scales, is common in the Siskiyou and Sierra Nevada Mountains. It does great damage to native bulbs of *Lilium kelloggi*, *L. washingtonianum*, and *L. rubescens*. So far as known, it has never been reported in cultivated plantings, but as thousands of collected bulbs are being taken into commercial cultures each year, the insect will bear watching. It is not a difficult matter to find the larvae or to kill them by hand. If the pack has been long in transit the pupa cases are commonly in evidence. They can be destroyed in the same way.

Bulbs of these lilies from this region which have the older portions eaten away and are filled with the frass of the insect should be carefully examined

[2] The portions relating to insects have been verified by the Bureau of Entomology, to which the reader is referred for further information on lily insects.

and the insects killed if found in the bulbs. In this region are found *Lilium pardalinum* and *L. humboldti*, but no instance has been observed in which bulbs of these species were injured by the larva of this moth.

The writer has never detected the insect in *Lilium washingtonianum* bulbs from the drainage of the Santiam, from Mount Hood, nor from the grain-fields of the Willamette Valley. In the Sierras in Butte County, Calif., it has been found very prevalent in the lower and the median distributional areas of the lily, but in the higher altitudes very few were found, even on the same mountain slope.

LILIES UNDER GLASS

At present only three species of lilies are used for forcing purposes to any extent in this country. Various forms of *Lilium longiflorum* (*L. longiflorum giganteum* ("gigs"), *L. longiflorum formosum*, *L. harrisii*, Erabu, etc.) are the most widely used and really eclipse all others. *Lilium speciosum* and *L. auratum*, however, are employed mostly for late blossoming in pots and for September decoration out of doors. The time was when *L. candidum* was the only lily forced for Easter decorations, but now, although well adapted, it is seldom used.

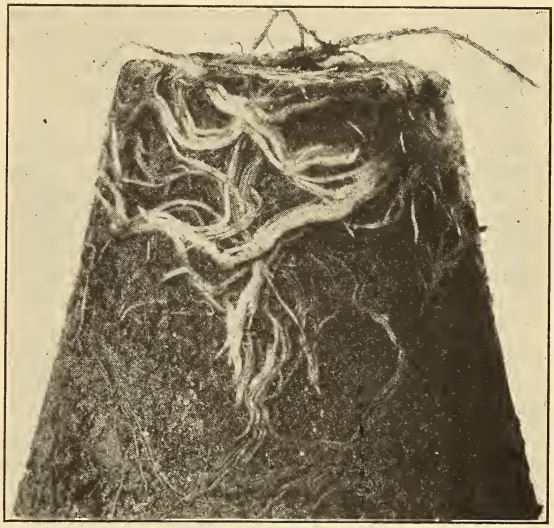

FIGURE 44.—Root system of *Lilium umbellatum*. Potted August 23 and photographed November 15. Another month's development is necessary before this should be brought into forcing conditions

There are, however, a great many lilies that can be forced just as well as those now employed for that purpose, and some of them are so used in foreign lands. The whole *Lilium umbellatum* (fig. 44) and *L. elegans* groups, as well as *L. testaceum*, may be brought in as early as *L. longiflorum*. The late-blossoming forms can be flowered in about the same season as *L. speciosum* and *L. auratum* and can be similarly handled. It is believed that there is a good forcing future for a number of lilies which have seldom been seen on our flower markets. As an example, it may be stated that *L. umbellatum* has met with a very favorable reception in one of the markets when presented experimentally.

If one is forcing freshly imported bulbs of *Lilium longiflorum giganteum* (gigs) as soon as they arrive in, say, October to December, they should be potted in good rich loam free of raw manures, watered, and then set away in frames on the surface of the ground or in well-drained pots and covered with earth or straw for four weeks or more, or they can be covered with débris on the benches in a house held at 50° to 55° F. at night, to root. They may then be given

a temperature of 55° to 60° at night until buds appear. Blossoms should open six weeks later at a temperature of 60°.

This may be taken as a general guide for forcing, but the process may be endlessly varied. *Lilium longiflorum formosum* may arrive in August and be flowered by Christmas or even Thanksgiving, but it must be subjected to a higher heat.

The degree of heat applied to lilies varies greatly. The optimum after the bulbs are well budded is about 65° F. and before they are rooted 50°. For general growth 50° to 55° is about right. However, bulbs are often rooted on the benches with or without a covering, and the variety *giganteum* from storage is successfully started at a temperature nearly as high as that advised for flowering. The day temperature during the development of the buds may be run up as high as 80° with a good moisture content in the atmosphere. Such treatment gives soft flowers and is justified only by the necessity of getting the plants into blossom by a certain date. Such high temperatures are possible only after the bulbs are well rooted. Usually a temperature of 70° at night is the limit.

While it is customary to advise the inquirer to get his lilies in bud six weeks before he wants them to blossom, the period is not at all exact. It is, however, long enough. The time required will be dependent upon the two main factors of heat and sunshine. During a recent winter the writer repeatedly and rather consistently flowered *Lilium longiflorum* seedlings in 28 to 30 days after the buds could be counted. It was done from February 1 on in a temperature of 65° to 70° at night.

The great consumption of lily blossoms is during the Easter festival, and very large quantities of various varieties of *Lilium longiflorum* are flowered for this date, but more especially large quantities of *giganteum*. The timing of the stocks to make them available for Easter is quite an art, and, it may be added, involves much labor. No lot of bulbs comes uniformly, but the variety *giganteum* is more tractable in this respect than any other. It is necessary to segregate the laggards and push them along with different treatment in order to get 90 per cent to flower on time.

On the other hand, when the crop is too forward, it is retarded by reducing the temperature or by moving the forward plants into cooler quarters to slow them up. There is quite a knack in proper retardation. It is considered better not to drop the temperature until the buds "show color." If the temperature is dropped seriously when the buds are only half grown, to the point of stopping development, they may not start again when heat is applied; but if retarding occurs after the first buds turn white, they will all open.

The development of cold-storage facilities has made a wonderful change in the handling of lilies. Now the blossoms may be had throughout the year. The bulbs are put in storage at a temperature of 33° to 36° F. in the cases in which they are imported and are taken out for potting as needed up to a year or more after importation. Bulbs that have remained in cold storage for a long time, however, are never as floriferous as fresh bulbs, although they may be forced in a shorter time.

The flowering of bulbs of *Lilium longiflorum* under dwelling-house conditions, where the actual date of flowering may not be

important, is not a difficult matter. The earlier the bulbs are potted the better. If at all possible they should root outside as previously described and should remain there until in danger from hard freezing. A drop to 28° F. will usually do no harm even if the plants are up. A growth of a few inches above ground may occur before the pots are brought inside. A cool but light situation is best until the pots are filled with roots. They can then withstand living-room conditions, where they will blossom in five or six weeks after the buds show and in from 12 to 14 weeks after being brought into the house.

Lilium regale, in spite of many statements to the contrary, is a good forcer. It can not, however, be subjected to heat before the first of the year, but it comes along rapidly after that date. Some objections are made to it as a forcing lily. The principal one is its legginess. It often becomes too tall for a pot plant. It must be admitted that this is ordinarily the case, but this does not militate against it as a cut flower. This objection seemingly may be corrected in a measure at least by placing the bulbs in storage for a short while before forcing.

The objection that has sometimes been raised to paucity of leafage can not be seriously entertained, for if the stem could be slightly shortened, the narrow, delicate leaves are graceful enough.

The writer's most successful method of forcing this lily in the vicinity of Washington, D. C., is to dig it from the field as near the first of the year as possible. It is potted immediately and put on the benches in a temperature of 60° F. at night until the tops appear, which should not take more than three weeks. The temperature may then be increased to 65° and then to 70° at night. This treatment will bring the earliest plants into flower by the middle of March. If wanted for Easter, a little lower temperature, possibly not over 65°, would be about right.

Lilium regale opens its flowers when cut and placed in water, and the first flowers open as well as *L. longiflorum*. It will stand retarding as well also, and the cut stems may be placed in cold storage successfully for a moderate period.

MARKETING OF FLOWERS

The production and marketing of lily flowers involve a very large amount of labor during the entire period of production. The bulbs are handled individually and mostly in individual pots with a shift to larger ones after growth starts. The plants require careful and intelligent watering, frequent fumigation, shifting, and rearrangement, to equalize the growth of varying developments. No method is known for bringing along uniformly a batch of lilies in forcing except to retard the precocious by reducing the temperature and pushing the laggards by increasing it for them. This means shifting from one temperature to another.

No small part of the work consists in getting the plants ready for delivery. Commonly each lily requires staking and tying, and just before delivery the flower cluster must be protected by tissue paper so that the swaying of the plants in transit will not bruise and destroy the flowers. The ideal lily for delivery in a pot to the customer is one with three or more buds and two opened flowers. It is

also necessary to remove the anthers of the flowers that have opened, otherwise the pollen smudges the blossoms. This is done with all lilies that are marketed open, although the beauty of the flower is thereby somewhat injured.

The time was when cut lilies were shipped with the flowers opened, which necessitated an expensive and careful pack. To-day they are almost entirely cut in bud, which simplifies and cheapens the pack and insures much better delivery.

The lilies are cut for shipment or storing when the first flower buds show color. They will then open satisfactorily when placed in water, although the individual flowers will be somewhat smaller than if opened on the plant. Practically all varieties of lilies will open their flowers in water when cut about the time the first flower is ready to open. Even a spike of *Lilium humboldti* having 30 or more flowers, which open over a period of two weeks, will open all of them on cut stems in water.

The packing of lily spikes for shipment does not differ materially from that of most other flowers. It is well to stand the cuts in water for a few hours. They are then packed dry quite tightly in boxes but without undue pressure and inclosed in oiled paper to prevent desiccation. As soon as unpacked they are again put in water, when the flowers unfold gradually, one after another, for a period of 10 days. Few cut flowers give such a long service.

If desirable for any reason, the opening of the flowers may be retarded by placing the cuts in a lower temperature. They are often held for two or three weeks in perfect condition, and fair success may be had for longer periods. Often the cuts are simply moistened by having water sprinkled over them, thus insuring a moist atmosphere, instead of placing them in vases of water. This prevents the decay that commonly occurs when they are stood in water for a long time.

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U. S. GOVERNMENT PRINTING OFFICE: 1930